HOWS AND WHYS OF COOKING

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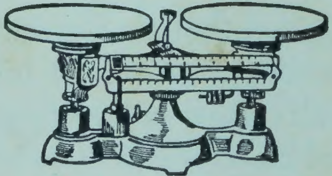
COOKING

BY

EVELYN G. HALLIDAY

AND

ISABEL T. NOBLE



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FOREWORD

All parts of this book have been revised or completely rewritten. The chapter on vegetables now includes directions for the newer methods of cooking and makes a general comparison of vitamin losses by all methods in common use.

In various muffin, cake, and pastry recipes the proportion of ingredients and the methods of combining them have been changed to accord with recent experimental work, which has resulted in better products than those made by the original directions.

A number of new recipes have been added, among which are some for ice-cream to be frozen in a mechanical refrigerator.

Over thirty new illustrations are included, a few of which replace those that were out of date, but most of which are entirely new. Thus we have a set of ten illustrating a special technique in making pastry.

The discussions and directions for cooking, in this edition as in earlier ones, represent the latest practical findings of a continuing program of experimental work. The purpose throughout has been to find methods which could be depended upon to give good food, the best possible according to our standards. In no case, however, do we claim to have found the one and only successful method, if, indeed, there is only one. What we have attempted to do was to develop methods that, in our opinion, gave first-class products, then to put into words the essentials of each, down to the smallest details, if we had evidence that such contributed toward success. At the same time we have tried to weed out various nonessential steps that have crept into certain methods of cooking. That we set ourselves rather a large order, too large to be carried out to a final conclusion for many products, will be realized by those who have struggled through the study of permutations and combinations in college algebra. The ordinary plain cake, for example, would have to

be made some thousands of times before all the possibilities of order and combination were exhausted. We have in such a cake six major ingredients—fat, sugar, egg, flour, baking powder, and liquid—all of which can be varied as to proportion and kind and also as to order and method of combining. Furthermore, temperature, humidity, and the personal factor introduce yet another series of variables. Hence it is that this cake recipe and many others probably still contain irrelevant details. We hope, however, that we have included the relevant ones and that our description of each process involved is such that it can be carried out with success by anyone who is willing to make an honest effort to follow directions.

We may add that while the explanations given here are the best we have to offer at the moment of writing, they, of necessity, leave much unsaid. Cooking processes are really most complicated and involve a knowledge of chemistry, both organic and physical; physics; botany; bacteriology; and, indeed, some phase or other of practically all the natural sciences. As a consequence, complete and fully adequate explanations will come only after much more experimental work has been done by those trained in many sciences.

For the new pictures in the chapter on beef and for assistance in revising the material we are again indebted to Mr. R. C. Pollock, Mr. Max O. Cullen, and Mr. Redman B. Davis, of the National Live Stock and Meat Board, all of whom made many valuable contributions to the second edition. We are also indebted to Mr. R. J. Eggert, of the American Meat Institute, and Mr. L. M. Wyatt, of the Bureau of Agricultural Economics, for the data which they kindly supplied.

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CHAPTER I

VEGETABLES

RAW vegetables, with their bright green, yellow, red, and white colors, are so good looking that many an enterprising grocer helps to sell his stock by making a pleasing window display of it. Such vegetables as are eaten raw reach the table still looking attractive—lettuce and radishes are even used as garnishes—but those that are cooked all too frequently lose every vestige of their original beauty during the process. At the same time, the good taste disappears, and they become flat and insipid or, worse still, strong and unpleasant, with an odor to match.

Cabbage, a vegetable especially rich in vitamins and one that is cheap and readily available a large part of the year, is almost invariably ruined in cooking. When raw it is a creamy white, with perhaps a tinge of green. It has a pleasing leafy structure

and a slightly biting flavor, of which most people are quite fond, as is evidenced by the favor in which this vegetable is held for coleslaw and as a salad ingredient. When cooked, it may well be as delicate and pleasing as when raw. Instead, it usually is changed completely and has a very strong taste; a disagreeable odor which penetrates to the farthermost corners of the house, where it tends to linger; and a most unappetizing dirty-brown color. So universally is this true that cabbage has acquired a very bad reputation and is seldom, if ever, served at the best eating-places. Indeed, a preference for it is taken as evidence of a most plebeian taste of the comic-strip variety.

It is our purpose to discuss the cooking of vegetables from three angles: the preservation of color, of flavor, and of nutrients. Sometimes one and the same method answers all purposes, but not always. In some instances we have to sacrifice one or another, but not all three, as is so frequently done.

PRESERVATION OF COLOR IN COOKING VEGETABLES

Vegetable colors fall into four groups—green, red, yellow, and creamy white—all of which are distinct chemical compounds of unlike properties. As a consequence, no general rule can be laid down for their preservation; each pigment must be considered by itself.

GREEN VEGETABLES

Chlorophyll, the coloring matter of green vegetables, is almost insoluble in water, as everyone knows who has noticed how little color there is in the cooking-water poured off such vegetables. Loss of green color during cooking is therefore not due to solution in the water but rather to a decomposition of the coloring substance.

As a matter of fact, the green pigment is very readily destroyed by adverse cooking conditions. Heat and acid are its enemies, and both have a chance to do their work when vegetables are long cooked. The acid which causes the trouble, surprising as it may seem, comes from the vegetable itself. One

may well ask why this acid does not bring about the destruction of the chlorophyll in the raw vegetables as well as in the cooked. The answer is that, in the raw state, chlorophyll, which is located in tiny compartments called "plastids," is surrounded by a semipermeable membrane that protects it from the action of acid. As cooking proceeds, however, this membrane becomes permeable, with the result that acid diffuses into the plastids and removes magnesium from the chlorophyll molecule. The derivative so formed is called "pheophytin" and has an unpleasant brown color; therefore, vegetables so cooked as to bring about this change in chlorophyll have a very poor color.[1]

Some comparative data on the rate of change caused by heat and acid were obtained some years ago in our laboratory. For this work, solutions of chlorophyll isolated[2] from spinach leaves were used. Portions of these were dropped into solutions[3] of different reaction—acid, neutral, and alkaline—and the time noted at which color changes occurred at different temperatures. A few of the findings are given in Table 1. The alkaline solution reported here had a reaction approximately that of Chicago city water, whereas the reaction of the acid one is comparable to that of certain other waters *after vegetables have been cooked in them* or to that of the liquid which condenses around steamed vegetables.

It may be observed that at both temperatures the color change was much slower in the slightly alkaline buffer than in

[1] Just for interest it may be stated that soluble compounds of copper and zinc will stabilize and intensify the color of chlorophyll even in acid solution. Some of our grandmothers turned this fact to account and kept their pickles green by making them in copper kettles. Apparently the copper, dissolved from the kettle, repaired the damage caused by the acid as fast as it was incurred.

[2] E. B. Hart, H. Steenbock, C. A. Elvehjem, and J. Waddell, "Iron in Nutrition," *Journal of Biological Chemistry*, LXV (1925), 67.

[3] For this study, Clark and Lubs's buffer solutions with a pH value ranging from 1.2 to 9.4 were used, as well as dilute solutions of hydrochloric acid and sodium hydroxide covering the same range of hydrogen-ion concentration as the buffer solutions. The rate of change was found to vary with the solution used, also with the solvent for the chlorophyll, but was always in the same *order* as that reported in Table 1.

the slightly acid one. Thus at 92° C. the color remained good for 50 minutes at pH 8.2, but for only 2 minutes at pH 5.4.

Actual cooking experiments on green vegetables bear out the findings of this study on chlorophyll solutions, although in vegetables the color change is slower, owing to the lesser accessibility of chlorophyll to heat in the plastids than in solution. Thus it is that the color will remain good in vegetables that need to be cooked but a few minutes, even if the cooking water is neutral

TABLE 1*

RATE OF DECOMPOSITION OF CHLOROPHYLL IN FAINTLY ACID, APPROXIMATELY NEUTRAL, AND FAINTLY ALKALINE SOLUTIONS

(Acetone Used as a Solvent for the Chlorophyll)

Reaction of Solution	Temperature		Length of Time Color Remained Good
	°C.	°F.	
Slightly acid (pH 5.4)	22–24	72–75	30 minutes
Approximately neutral (pH 7.2)	22–24	72–75	2 hours
Slightly alkaline (pH 8.2)	22–24	72–75	48 hours
Slightly acid (pH 5.4)	90–92	194–198	2 minutes
Approximately neutral (pH 6.8)	90–92	194–198	8 minutes
Slightly alkaline (pH 8.2)	90–92	194–198	50 minutes

* Experimental work by Callie M. Coons.

or faintly acid, whereas vegetables cooked 20 minutes or longer lose their bright green color unless the water is slightly alkaline, as is that of Chicago and, indeed, of most natural waters throughout the country. Even "soft" waters, it should be noted, will be alkaline, if, as frequently happens, they contain carbonates of sodium and potassium. That this is true may seem a bit surprising to some of us who are accustomed to think that the only alkaline waters are "hard" ones containing compounds of calcium and magnesium which react with soap to form a curd, thus giving us visible evidence that the water is "hard."

There are two general methods of cooking green vegetables that can be counted on to keep the color good. In the first, which

until recently was the only one, the vegetable is dropped into enough rapidly boiling salted water to cover all parts completely and boiled continuously until tender, preferably without a lid, particularly during the first few minutes of cooking. The point in leaving the lid off at first is to allow the volatile acids, which are evolved in greatest abundance almost immediately, to pass off in the steam.

The value of using enough water to cover the vegetables is that by so doing we dilute and, if the water is alkaline, partially neutralize the nonvolatile vegetable acids as they come off. If we use a small amount of water—especially water with no free alkali to dispose of the acid, as would be the case if we used neutral water[4]—we may well reach a concentration of acid which is quite sufficient to accelerate materially the decomposition of the chlorophyll. In cases where neutral water must be used, we shall, if we want to preserve the color, have to add a tiny speck of soda, not more than one-sixteenth of a teaspoon per quart of water, for all green vegetables except spinach and other tender greens. These cook very quickly—in other words, before heat and a little acid have time to do much damage. Any appreciable excess of soda is to be avoided, not because of its effect on the color, for it will intensify that, but because it will make the vegetable soft and slimy, a most unpleasant condition, and because it will tend to destroy vitamins and the natural flavor.

The other satisfactory method of cooking green vegetables is the comparatively new one involving the use of a pressure saucepan. In this utensil the temperature reached is sufficiently high to shorten the cooking-time so materially that the color will remain good, in some cases, peas for example, even better than in the open kettle; in others, such as Brussels sprouts, nearly as good. Precautions have to be taken, however, not to use more than the prescribed portion of vegetable for a given size of saucepan. If too large an amount is used, the cooking-period is

[4] Distilled or rain water, or water obtained by melting snow or ice, is usually approximately neutral when boiled.

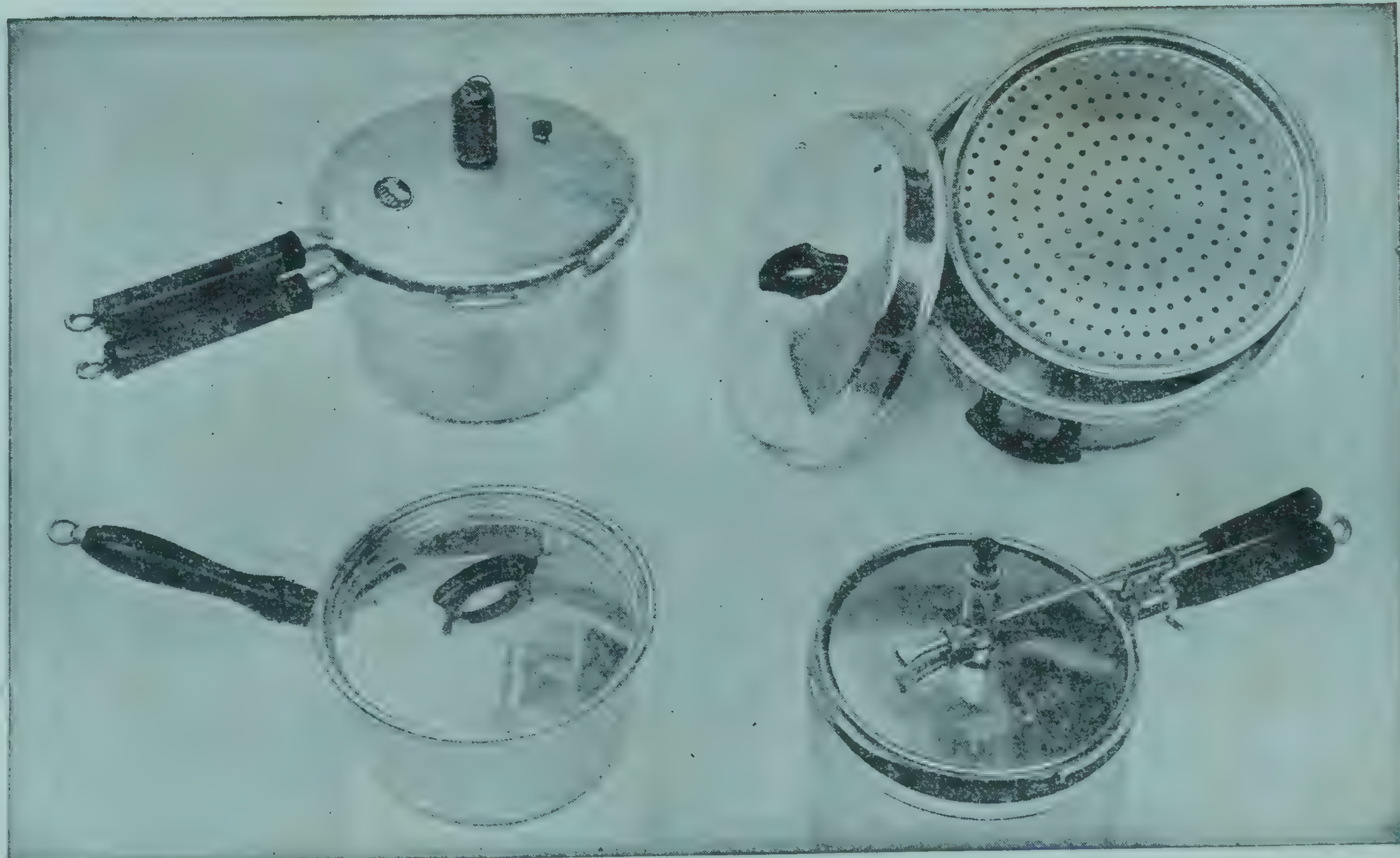


FIG. 1. A pan with tight-fitting lid, a steamer, and two pressure saucepans

prolonged, with the result that the color is not so good as it would otherwise be. As will be discussed presently, this method of cooking results in less loss of flavor than does the open kettle and usually also in less loss of soluble nutrients.

A comparison of the color of peas and green cabbage cooked by these two methods and by two others to be given later is shown in Table 2.

TABLE 2*

JUDGES' SCORES FOR THE PALATABILITY OF PEAS AND GREEN CABBAGE COOKED BY DIFFERENT METHODS

(Highest Possible Score, 5; Lowest, 1)

Vegetable	Quality Factor	Open Kettle	Tightly Covered Saucepan	Pressure Saucepan	Steamer
Peas	Color	3.5	2.1	4.8	2.2
	Flavor: intensity of natural	2.7	3.8	4.1	3.0
	Texture	3.8	3.7	3.9	3.5
Cabbage, green, from a loose head	Color:				
	Green	4.8	2.4	4.0	2.4
	White	4.7	3.1	4.5	3.1
	Desirability of aroma	4.6	2.7	3.9	2.6
	Flavor:				
	Desirability	5.0	3.2	4.2	3.0
	Intensity of natural	2.4	3.8	4.5	3.6
	Texture	4.1	3.7	4.1	4.0

* Experimental work by Claire Kercher.

For both methods of cooking, the importance of shortening the time can hardly be overemphasized. Various devices can be employed for doing this. Thus, in the open-kettle method, by having the water really boiling when the vegetable is put into it and by keeping it boiling throughout the cooking-period and, in the pressure-saucepan method, by heating as rapidly as possible until the desired temperature is reached, considerable time is saved.

Cutting green beans in strips lengthwise shortens the cooking-period and gives a product with a most attractive bright-green color.

Removing the stems from spinach cuts the cooking-time almost in two. This is not so impracticable a performance as one might imagine. It really takes little, if any, longer to prepare spinach for cooking without the stems than with them, for the time lost in snipping off the stems is about made up in the shorter time required to wash the stemless leaves. In so far as food value is concerned, discarding the stems is not a particularly wasteful practice, since they have been found to have only a third as much iron[5] and ascorbic acid, a fourth as much thiamine, and half as much riboflavin as the leaves.[6]

Summarizing, then, our conclusions regarding the cooking of green vegetables in such a way as to preserve their color, we find that they may be cooked in either of two ways—in rapidly boiling water to cover or in a pressure saucepan—but that, whichever method is employed, the cooking-time should be as short as possible.

YELLOW VEGETABLES

The coloring matter of bright-yellow vegetables, such as carrots, squash, and sweet potatoes, belongs to a class of pigments called "carotenoids." Surprisingly enough, these carotenoids are also invariably present along with chlorophyll in green vegetables, on the average in the proportion of 3.5 parts of chlorophyll to 1 part of the carotenoids. Under normal conditions the yellow is entirely masked by the green, and it is only when the latter disappears that the yellow shows up. Thus it is that we are not aware of the yellow in the leaves until the autumn, when the chlorophyll disappears. And so it is in cooking green vegetables; if we destroy a large part of the chlorophyll, the little that remains plus the yellow carotenoids gives our cooked vegetables a bronze-green color.

It has recently been found that some of the yellow pigments

[5] Experimental work by Margaret Abt Bloom.

[6] Margaret Phillips, Nancy Dickerson, and Faith Fenton, "The Ascorbic Acid, Thiamin, and Riboflavin Retention in Fresh Market, Home Frozen, and Commercially Dehydrated Spinach Cooked by Several Methods," *Progress Notes, National Cooperative Project, Conservation of Nutritive Value of Foods.*

(kryptoxanthin and the commonly occurring carotenes[7]) can be transformed by the animal body to vitamin A; hence yellow vegetables and fruits are important sources of this vitamin.

The yellow pigments are almost insoluble in water and are quite stable, being but little, if any, affected by the conditions of cooking. The darkening occasionally seen in the cooking of yellow vegetables is more probably due to the scorching of the sugary juice than to a decomposition of the yellow pigment. As a matter of fact, in so far as the carotenoids are concerned, yellow vegetables will retain their color regardless of the method of cooking employed, provided they are not overcooked.

RED VEGETABLES

Red vegetables are rare, being limited chiefly, in this part of the world at least, to radishes, beets, and red cabbage, the last of which might more properly be called purple than red. The coloring matter of these vegetables belongs to a group of pigments called "anthocyanins," which are also responsible for most of the color of red, purple, and blue flowers and fruits.[8] So wide is their distribution in nature that they deserve a little more attention than their limited occurrence in vegetables would warrant.

There appear to be any number of anthocyanins, most of which are soluble in water and give a bright-red color in distinctly acid solution. They differ from each other slightly in their chemical composition and considerably in their color reactions with certain metals and with acid or alkali of different concentrations. For example, if alkali is added gradually to the distinctly acid solution of a water extract of red cabbage, the red color changes first to purple, then to blue, and finally to green, with all possible intermediate shades. Moreover, the whole series of color changes appears before the neutral point is reached—in

[7] E. G. Halliday and I. T. Noble, *Food Chemistry and Cookery* (Chicago: University of Chicago Press, 1943).

[8] The coloring matter of red tomatoes is not an anthocyanin, but a carotenoid called "lycopene." This pigment is an isomer of carotene, the coloring matter of carrots.

other words, while the solution is still slightly acid.[9] Similar color changes occur upon the addition of tin, aluminum, zinc, and various other metals in soluble form.

The water extract of red beets does not behave like that of red cabbage. When alkali is added gradually, no appreciable color change occurs until the neutral point is passed and the solution is slightly alkaline. Then the color changes from red to purple and soon begins to fade. Furthermore, metals appear to have no effect on the color.

In general, these color changes are all reversible within a reasonable time limit. This means that adding acid will undo the work of alkali—of metals also, it happens—and will give back the original red color, provided the time of adding it is not too long delayed. The red form appears to be the stable one; the others are more or less unstable, with a tendency to fade to colorless forms.

Color changes similar to those just discussed are met with in cooking vegetables and fruits containing anthocyanins. Red cabbage, for example, does not stay red during cooking unless we actually add acid to the cooking-water in the form of vinegar, lemon juice, or even tart apples. Without added acid, the color turns purple or blue in neutral water, green in alkaline water. The same thing happens in steaming, save that the color change stops at the bluish-purple stage.

At first thought, it may seem rather peculiar that the cabbage should acquire a bluish tint when steamed, a change associated with a decrease in acidity or with the addition of certain metals. If the acidity changed, however, we should expect it to follow the usual pattern in cooking vegetables and increase. And as for metals, none were added in the steaming process.

An examination of a raw sample, however, will give a possible clue to an explanation. It will be observed that red cabbage is not uniformly red, but, instead, has red layers superimposed on

[9] According to Clark (*The Determination of Hydrogen Ions* [Baltimore, 1928], p. 86), the color range as a pH value is red 2.4 to 4.5 green.

white ones of varying thickness. Judging from the color change on steaming, we may assume that the acidity and perhaps also the metal content of the two layers is not the same and that when the vegetable is cooked and the cell membrane becomes permeable, so that there is free diffusion of juices from the white to the red and vice versa, the chemical composition of the red layer becomes such as to favor a change toward the blue. Whatever the cause of the color change, it can be reversed to the red by the addition of a little acid.

Many fruits have anthocyanins very similar to the one in red cabbage. This is shown by the color change which may occur in cooking or canning such fruits. Certain blue ones—plums, for example—develop a reddish shade when cooked, apparently because the juice of the fruit as a whole is more acid than the original color-bearing part. Red fruits, on the other hand, sometimes turn purple when canned. This change was most puzzling until Culpepper and Caldwell[10] showed that it occurred only when tin containers were used and that it was caused by a reaction between the anthocyanin of the fruit and the tin of the can. This purple color acts just like that produced by alkali and tends to disappear when acid is added.

In cooking beets we find, as we might expect from the behavior of their water extract, that the acidity of their own juice is enough to maintain the color. Therefore, so long as we do not pare beets or cut them up, we can cook them in any kind of water without adding extra acid and still have the color good. Besides, we can steam them or cook them in the pressure saucepan without loss of color, and by such means preserve flavor and nutrients as well.

Briefly, then, the best conditions for cooking red vegetables—and fruits—are just the opposite of those for green. For the red, acids favor color retention; whereas alkalies and certain metals cause undesirable changes, perhaps even complete loss of color.

[10] "The Behavior of the Anthocyan Pigments in Canning," *Journal of Agricultural Research*, XXXV, No. 2 (1927), 107–32.

WHITE VEGETABLES

We are not accustomed to think of white vegetables as containing any color; and it is possible that some of them—Irish potatoes and white onions, for example—do not. A large number of them, however, contain minute amounts of either the yellow carotenoids, which, as we have just seen, are not affected by cooking, or of another class of peculiar pigments not yet mentioned. These are the flavones, pigments which in low concentration are almost, if not quite, colorless, especially in dilute acid solutions such as are most vegetable juices, but which turn yellow in alkali and brown or green with iron. Even the little bit of alkali in tap water may be sufficient to give a pronounced yellow color to vegetables like yellow-skinned onions, which contain an appreciable amount of these pigments. If the vegetable turns yellow, so, too, will the cooking-water; for the flavones, being easily water-soluble, are largely dissolved in the water. This yellow color is pleasant rather than otherwise, and consequently there is no objection to its appearance.

There is, however, a disagreeable, and as yet unexplained, color change which may occur in cooking white vegetables. They turn a brownish gray. This color appears almost invariably on long cooking of all white vegetables and is decidedly ugly. Although we do not know why it comes, we may hazard the guess that the flavones have something to do with it, perhaps by diffusing until they come in contact with the iron of the vegetable and with it forming the dark compound already mentioned. Or in long cooking some of the flavones may be changed over to their near relatives, the anthocyanins, in one of the latter's unpleasant dark-colored forms. If such is the case, the addition of a little acid in the form of vinegar or lemon juice will cause a reddening of the vegetables. A color change of this kind is sometimes observed in long-cooked cabbage when acidified.

There is also the possibility that, in long cooking, the iron and sulphur of the vegetable have a chance to get together and form a dark compound.

Whatever the cause, it is certain that white vegetables do not

darken unless overcooked. Hence this unpleasant change may be avoided by cooking such vegetables only until tender. It happens that most of the white ones belong to the cabbage family; therefore, as we shall see presently, by short cooking, which prevents darkening, we tend also to prevent the development of bad taste and odor.

PRESERVATION OF FLAVOR IN COOKING VEGETABLES

All vegetables tend to lose some flavor on cooking, the extent of the loss depending on the amount of surface exposed, the proportion of the cooking-water, and, above all, on the length of the cooking-period.

Sugar is the one flavoring substance lost that has been identified and measured, but there are many others of unknown composition that determine the characteristic flavor of each vegetable. If appreciable quantities of these substances and of sugar are lost, the vegetable becomes flat and insipid. It helps a little, when vegetables are cooked in any appreciable quantity of water, to add approximately the same amount of sugar as of salt to the water.

Worse, however, than the loss of some good flavor, is the gain of an undesirable one, which can happen to any vegetable, even to the mild-flavored carrot, if it is long overcooked. But the vegetables most likely to acquire a bad flavor are those of the cabbage family, the so-called Brassicaceae, which includes Brussels sprouts, broccoli, and turnips. These vegetables, along with onions, are sometimes classed as "strong-juiced," which is something of a misnomer so far as the cabbage family is concerned, for the vegetables in this group are really not "strong-juiced" when raw and do not necessarily become so when cooked. Such vegetables contain sulphur compounds, which in their natural state are rather sharp, but withal pleasing, in taste and not at all suggestive of what we have in mind when we say "strong." These compounds, however, are of such a nature that they break up easily under unfavorable conditions of cooking and give, as a product of their decomposition, substances of dis-

agreeable taste and smell. One of these substances has been found to be hydrogen sulphide, which is also one of the things formed when eggs spoil and is largely responsible for their offensive odor. It may seem, at first thought, that any compound which is capable of yielding anything so unpleasant as hydrogen sulphide must of itself be repulsive; but that such is not the case we can easily see if we think of the possible decomposition products of many mild and pleasant substances. Take common table salt, for example; under proper laboratory conditions it can be made to yield sodium, a most active and dangerous element, and chlorine, which was one of the poison gases used during the first World War. Fortunately, table salt, as everyone knows, is a very stable compound and cannot easily be split into its component parts under any conditions, certainly not those of cooking. Some of the sulphur-yielding compounds of vegetables, however, are not stable; instead, they readily go to pieces. The way to make this happen is to cook the vegetable for a long time, particularly in the presence of a little acid, as we do when we cook in a steamer or in a small amount of water. We probably increase the chance of decomposition also by heating very slowly at first, thus giving the plant enzyme which caused the synthesis of the sulphur compounds in the growing vegetable a chance to go into reverse action and decompose them. We do this when we put the vegetable on to cook in tepid water and allow it to heat up very slowly.

One way to prevent decomposition in these vegetables, in other words prevent making them strong-juiced, is to drop them into rapidly boiling water and cook for the shortest time required to make them tender. Another way, applicable to most vegetables of this type, is to cook them in the pressure saucepan, also for the shortest time possible.

For a comparison of the flavor of cabbage (loose head, green) cooked by these two methods and two others see Table 2.

Onions really are strong-juiced, and they owe their "strength" to volatile constituents already pre-formed in the raw vegetable, of which we are well aware as we wipe away the tears which

gather in our eyes when we peel them. They do not behave at all like the cabbage family on cooking; for, instead of developing a new flavor, they simply tend to lose the one they originally had and, on long cooking, so much of the flavor may pass off with the steam that the cooked product is flat and insipid. For most people there is a happy medium in the retention of onion flavor, which is brought about by cooking the onions until tender, and no longer, in a fairly large proportion of rapidly boiling water. This, by the way, is quite as effective and far less trouble than changing the water, as is sometimes recommended.

PRESERVATION OF NUTRIENTS IN COOKING VEGETABLES

Although we have given first place to the preservation of color and flavor—the two factors which determine the relish with which a vegetable will be eaten—we are by no means unmindful of the importance of the preservation of nutrients, a subject which will now be considered.

Of four methods of cooking in common household use—boiling in water to cover in an open kettle; cooking in the smallest possible quantity of water to prevent scorching of the vegetable, in a tightly covered kettle; cooking in a pressure saucepan, also in a small quantity of water; and cooking in a steamer, where no water is in contact with the vegetable—one might assume that the retention of soluble nutrients would be lowest in the first-named method and highest in the others, in which little or no water is used. That this assumption holds for some, but not necessarily for all, vegetables is shown by recent studies. Data illustrative of the differences commonly found are given in Table 3. Thus, for example, cabbage cooked in an open kettle retained only 33 per cent of its ascorbic acid, whereas, cooked in the other three utensils, it retained 72–74 per cent of this vitamin. The results for thiamine and riboflavin were in the same order. It may be noted, however, that for spinach and green beans, the ascorbic acid retentions were similar by all methods. Just why these particular samples behaved in this way we are unable to say. We include the data concerning them simply to

show that retention of ascorbic acid is not invariably lowest by the open-kettle method.

In so far as calcium and phosphorus are concerned, Table 3 offers evidence that the retentions are as high in the open-kettle as in the other methods. That this is true for calcium might be expected[11] from the fact that the water used had a high calcium

TABLE 3*

THE PERCENTAGE RETENTION OF ASCORBIC ACID, THIAMINE, RIBOFLAVIN, CALCIUM, AND PHOSPHORUS IN VEGETABLES COOKED BY DIFFERENT METHODS

Nutrient	Vegetable	Open Kettle	Tightly Covered Saucepan	Pressure Saucepan	Steamer
Ascorbic acid.....	Peas	55	86	80	75
	Cabbage	33	74	74	72
	Spinach	39	42	38	31
	Green beans	68	70	72	75
Thiamine........	Peas	72	92	91	91
	Green beans	68	82	84	84
Riboflavin.......	Peas	58	87	86	86
	Green beans	75	92	91	97
Calcium..........	Carrots	94	90	89	....
	Cauliflower	92	100	94	....
Phosphorus.......	Carrots	84	81	83	....
	Cauliflower	73	78	85	....

* Results on vitamins are compiled from studies by C. Kercher, R. Weinberger, H. Smith, E. Waddell, F. Turnbull, and J. Spear; those on calcium and phosphorus from E. Brinkman's work (*Food Research*, VII [1942], 300–305).

content. The similarity of the phosphorus retention by the three methods would, of necessity, indicate that the compounds in which this element is present in these vegetables are not appreciably soluble in water or are not diffusible through the vegetable membrane.

It should be added that in order to have the proportion of water a factor of importance in the retention of vitamins this proportion must be very small, perhaps no more than one-

[11] I. Noble and E. G. Halliday, "Influence of Calcium in Cooking Water upon Mineral Content of Vegetables," *Food Research*, II (1937), 499–503.

fourth the quantity required to cover the vegetable. In other words, a slight reduction has no appreciable effect. As a matter of fact, it has been found that using just half the quantity required to cover did not significantly lower the retention of ascorbic acid in cabbage.[12]

Another factor that has been thought to affect materially the retention of soluble constituents in cooking vegetables in appreciable quantities of water is the way the vegetable is prepared for cooking. If it has much cut surface exposed to the action of water, particularly surface cut crosswise of the fibers, the losses have been assumed to be heavy. That this supposition is not invariably true for ascorbic acid is shown by a recent study, in which the losses were approximately the same in rutabagas cut into ½-inch cubes and ½-inch lengthwise slices; in cabbage cut in ¼-inch strips and 1½-inch wedges; and in green beans cut into 1-inch lengths and left whole. The beans, when Frenched, however, showed almost twice as great a loss as when cut into 1-inch pieces or left whole.[13]

Slight overcooking apparently has no appreciable effect on losses, at least in so far as boiling is concerned. For example, cabbage cooked 25 minutes showed no greater loss than when cooked for 7 minutes.[14] Long cooking to the point of mushiness would, of course, so disintegrate the cells as to allow nutrients to come out in quantity. As has been said, however, even slight overcooking beyond the point required to make the vegetable tender has a decidedly adverse effect on color and flavor.

One question that always comes up in cooking vegetables is what to do with the cooking-water. One suggestion is to serve it with the vegetable, which is probably equivalent to throwing it away, for it is extremely doubtful if anyone ever eats it. Besides, a vegetable served in a watery bath is not nearly so palatable as one drained and served with a little butter. If this

[12] F. O. Van Duyne, J. T. Chase, and J. I. Simpson, "Effect of Various Home Practices on Ascorbic Acid Content of Cabbage," *Food Research*, IX (1944), 164–73.

[13] Experimental work by Joyce Spear.

[14] Van Duyne, Chase, and Simpson, *loc. cit.*

practice is not followed, how, then, can the water be used to advantage? One person we know drinks it on the spot, which is an excellent idea, although perhaps a bit inconvenient at times. The most common suggestion is to save it until a convenient time arrives to use it in soups, gravies, or cocktails. This idea, too, is good, and the sooner it is followed, the better. We have found that even when stored in a covered receptacle, the ascorbic acid content tends to disappear rapidly. Thus, for peas,[15] only one-fifth of the original value remained after two days.

No discussion on the preservation of nutrients by different methods of cooking would be complete without mention of baking, a method applicable to a few vegetables and presumably a very efficient one. Even so, there may be some loss of ascorbic acid. This was indicated by some recent[16,17] studies on potatoes, in which it was found that the retention was 88 per cent when first baked, but only 74 per cent after standing for 11 minutes and 61 per cent after 26 minutes.

DIRECTIONS FOR COOKING AND SEASONING VEGETABLES

The cooking-unit we have chosen is the amount which measures 2 cups when cooked and prepared for seasoning. This measure we call four servings, thus allowing ½ cup for each individual portion. Four servings, however, are not necessarily enough for four people. Indeed, if vegetables are so cooked as to be attractive in color and pleasing in taste, four servings may well be just barely enough for two people.

MEASURE AND WEIGHT OF FOUR-SERVING PORTIONS

In Table 4 we have given the approximate measure and weight of vegetables as purchased in the city markets and also the weight of the edible portion which yields four servings.

[15] Experimental work by Claire Kercher.

[16] R. Kahn and E. G. Halliday, "Ascorbic Acid Content of White Potatoes as Affected by Cooking and Standing on Steam Table," *Journal of the American Dietetic Association*, XX (1944), 220–22.

[17] F. O. Van Duyne, J. T. Chase, and J. I. Simpson, "Effect of Various Home Practices on Ascorbic Acid Content of Potatoes," *Food Research*, X (1945), 72–83.

Quite obviously, the measure and weight as purchased are only approximations and vary with the vegetable itself and with the cook's method of preparing it for the table. For example, the weight of asparagus-as-purchased required for four servings—2 cups when cooked—has been found in this laboratory to be anywhere from 1 to 2 pounds. The latter value was for a sample from an early, long-distance shipment. This asparagus had large, tough stalks, most of which were too woody to cook and therefore had to be discarded. The better sample was home grown and had very tender stalks, nearly all of which could be cooked. In view of the possibility of such marked variations, we have been careful in working out the values for our tables to use a uniform grade of vegetables, and *that* the best obtainable in the city markets.

This precaution, however, does not eliminate the variable introduced in the preparation for cooking. Thus, referring again to asparagus, one cook may use only the tips, whereas another may use as much of the stalk as can be made tender on short cooking. We assume the latter practice to be the common, also the desirable, one and therefore have followed it for our tables. We judge the tenderness of the stalks by the way they break, and we discard all below the point where a sharp, quick break can be made.

For purposes of economy and for uniformity in reporting results, we have adopted the general policy of eliminating all unnecessary waste in preparing vegetables for cooking. But even by doing this and by choosing vegetables of the best quality, our measures and weights as purchased show considerable variation. The values given are therefore intended only as a general guide to the inexperienced.

PREPARATION OF VEGETABLES FOR COOKING

The method of preparing individual vegetables for cooking is given in Tables 5–8. It will be observed that we coarsely shred cabbage; separate cauliflower into flowerets; cut rutabagas and turnips into small pieces; and partially quarter Brus-

sels sprouts, in other words, slit crosswise at the bud end (see Fig. 2). Our reason for cutting is to shorten the cooking-period and thus prevent the development of the unattractive color and bad taste and odor already discussed.

Asparagus and broccoli may be cooked successfully in either of two ways: the stems may be split into fairly narrow length-wise strips but left attached to the tip (as in Fig. 3), or they

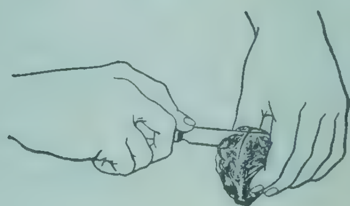


FIG. 2.—Partially quartering Brussels sprouts

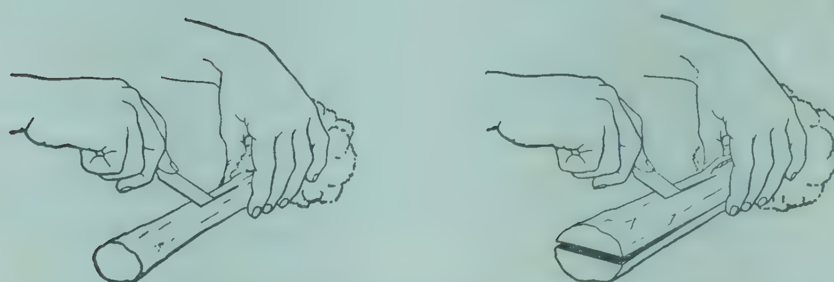


FIG. 3.—Splitting the stems of broccoli

may be cut off and cooked separately for 15–20 minutes, after which the tips are added and cooking continued for 5–10 minutes longer. We prefer the former method, since the short cooking period leaves the stems as attractive in color as the tips.

As has been stated, we are in favor of removing the stems from spinach in order to shorten the cooking-time and improve the color.

With but few exceptions, the four-servings portions of the vegetables can be prepared for cooking in 2–3 minutes. Brussels sprouts, asparagus if dirty, peas, and spinach, however, may re

quire as long as 10 minutes and Hubbard squash even longer, unless the grocer can be persuaded to saw it into pieces suitable for cooking.

GENERAL INFORMATION REGARDING COOKING-PROCEDURES

In addition to indicating the method of preparing vegetables, Tables 5–8 give the quantity of water to use and the approximate cooking-time for each method of cooking.

It will be noted that the amount of water called for in boiling (Table 5) varies with the type of vegetable. For the green and for members of the cabbage family, the amount used is about the minimum required to preserve the color and prevent the development of a bad flavor, provided the water used is slightly alkaline (as is that of Chicago, pH 8.2 before boiling, and of the majority of places throughout the country) and the vegetables are cooked in an uncovered pan of the size mentioned, for approximately the time specified. With pans shallower than the ones we use, the amount of water would have to be increased, of course, to allow for more rapid evaporation. For other vegetables the quantity of water is simply that which we have found necessary in order to cook the vegetable until tender without boiling dry in a loosely covered kettle. In tightly covered kettles even less water is needed (Table 7), for not much of it is lost by evaporation. When using these kettles, however, one should be sure to turn the flame high until steam begins to come off, then turn it very low.

In addition to the general directions in Table 6 for the use of the pressure saucepan, we are including two series of pictures (Figs. 4–8 and 9–16), which, with their legends, give specific directions for each step in the manipulation of two types of these saucepans.

Directions for cooking frozen vegetables by two methods are given in Table 9. It will be observed that, unlike some workers, we do not recommend partially thawing the vegetables before cooking. We simply break them up a bit and immediately put them on to cook.

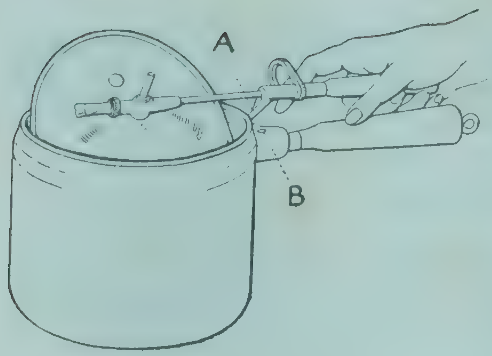


FIG. 4.—Place the rack and water in the pan, heat the water to boiling, and immediately add the vegetable. Then slip the lid into the pan and set the spur *A* in socket *B*.

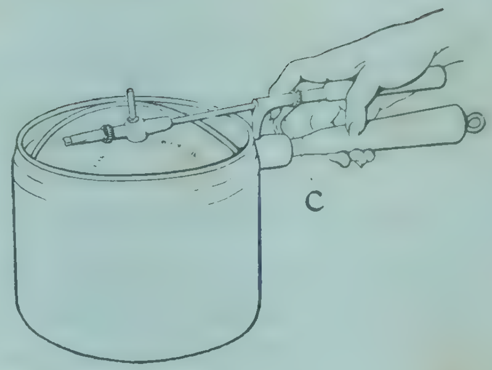


FIG. 5.—Hold the lid beneath the rim of the pan, tip it to an approximately horizontal position, and place the finger around hook *C*.

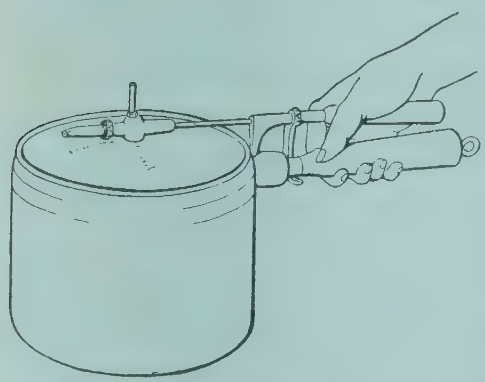


FIG. 6.—Squeeze the handles together and push the hook *C* as far around the lower handle as possible. Heat strongly until steam flows from the vent (see Fig. 7).

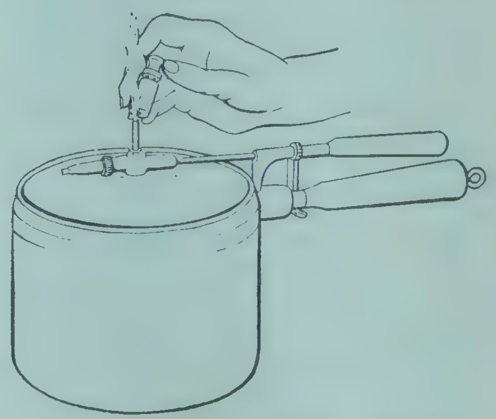


FIG. 7.—Set the weight over the vent, continue to heat strongly until the indicator comes to the center of the scale, then lower the heat sufficiently to hold the indicator there until the cooking-time is up.

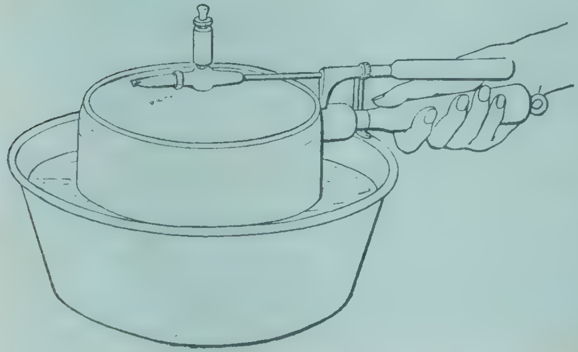


FIG. 8.—Cool the cooker by setting it in cold water or by letting cold water run over it, until the indicator has returned to the original position. Remove the weight, then the lid, and serve immediately.

Steps in vegetable cookery using one type of pressure saucepan

Fig. 9.—Place the rack and water in the pan, heat the water to boiling, and immediately add the vegetable. Grasp the handle of the lid with the right hand and that of the cooker with the left. Set the cover on the cooker with the handle just far enough to the right of the cooker handle to permit the lid to fit snugly.

Fig. 10.—Pull the cover handle to the left until it rests directly over the cooker handle. This locks the lid in place.

Fig. 11.—Heat strongly until all the air is out of the kettle, as indicated by a brisk evolution of steam, then put the weight over the vent pipe.

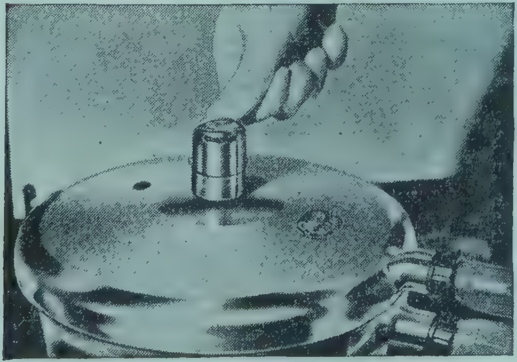


Fig. 12.—Push the weight down on the vent pipe until it clicks into position.

Courtesy of the National Pressure Cooker Company

Steps in vegetable cookery using a second type of pressure saucepan (continued in Figs. 13–16).

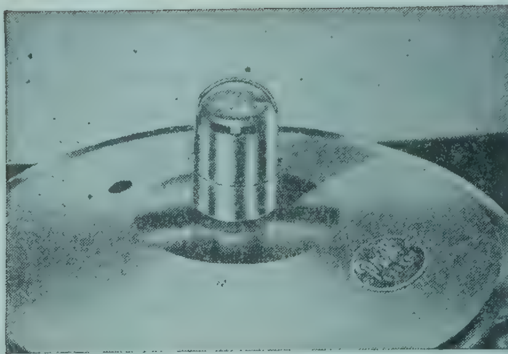


Fig. 13.—Continue to heat strongly until the indicator comes to "cook," then lower the heat sufficiently to keep the indicator there throughout the cooking period.

Fig. 14.—When the vegetable has cooked for the required time, cool the cooker rapidly by setting it in a pan of cold water or (see Fig. 15) by letting cold water run over it.

Fig. 15.—The cooker may be cooled, if preferred, by letting cold water run over it rather than by setting it in water.

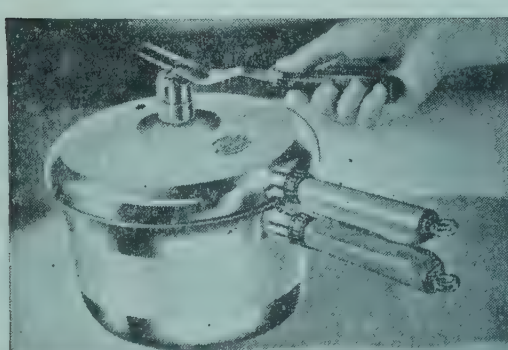


Fig. 16.—As soon as the indicator shows that the pressure is down (which will take 15–20 seconds), remove the weight, then the lid, and serve the vegetable immediately.

Courtesy of the National Pressure Cooker Company

Steps in vegetable cookery using a second type of pressure saucepan (continued from Figs. 9–12).

For all methods of cooking in which water is used we salt the water before adding the vegetable. This improves the color of the green and the flavor of all, and, in addition, tends to preserve the ascorbic acid.[18]

The cooking-times given in the various tables are intended as general guides rather than as periods that can be followed rigidly. If the vegetables are mature or have been shipped a long distance or perhaps allowed to stand in the store or at home, they will undoubtedly require a longer period than we give. If, on the other hand, they are young and tender, perhaps right out of the garden, they will certainly cook in a shorter time than we give. Furthermore, different varieties may show a variation in cooking-time. All in all, then, it is evident that no hard-and-fast rule can be given. It is possible, however, with all methods save that using the pressure saucepan, to do a little testing as cooking proceeds and thus avoid overdoing the process. For the pressure saucepan one will simply have to recook if the vegetable is underdone and, if it is overdone, reduce the time when next a similar vegetable is cooked.

SEASONING VEGETABLES

Buttering.—All vegetables are greatly improved by shaking them over a low flame after they have been drained. Doing this removes the last traces of cooking-water and renders starchy ones, such as Irish potatoes, dry and mealy.

One and one-third tablespoons of butter for each 2 cups of cooked vegetable or 1 teaspoonful for each individual half-cup serving is a reasonable amount to allow for all vegetables save Irish potatoes, Hubbard squash, and rutabagas when they are mashed. For these, 2 tablespoons for each 2 cups of vegetable may be used.

Creaming.—Such vegetables as asparagus, green beans, Brussels sprouts, cabbage, carrots, cauliflower, onions, and green peas are very good when served with cream or a rather thin

[18] E. H. Pendleton, "A Function of Salt in Preserving Vitamin C," *Canning Trade*, LXV (1943), 15.

white sauce. For all of these save peas we allow $\frac{1}{2}$ cup of cream or white sauce for the 2-cup portion of vegetable; for peas, $\frac{3}{4}$ cup. Directions for making white sauce are as follows:

WHITE SAUCE

Yield

One-half cup.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Butter	13	1 tablespoon
Flour (family or cake)	5	2 teaspoons
Milk	122	$\frac{1}{2}$ cup
Salt		$\frac{1}{4}$ teaspoon

Order of work

1. Place the butter in a small saucepan holding approximately 2 cups or in the same pan in which the vegetable was cooked, provided it was drained and left in a sieve. Melt the butter over a low flame; add the flour and salt; stir them with the fat until all are well combined.
2. Remove from the fire; add about 1 tablespoon of the milk and stir until the mixture is smooth. Then add the rest of the milk slowly, stirring while it is being added.
3. Return to the fire and cook slowly until the sauce comes to the boiling-point. The mixture must be stirred constantly to prevent lumping and scorching.

Special methods of seasoning certain vegetables.—(*a*) Candying sweet potatoes: Place cooked potatoes in a shallow pan. Add to them a mixture consisting of $\frac{1}{4}$ cup of light-brown or white sugar and 2 tablespoons of water. (If the potatoes are boiled, the water may be evaporated to this amount if care is taken to prevent scorching.) Add $1\frac{1}{3}$ to 2 tablespoons of butter. Heat over a low flame or in an oven at 500° F. If candied over a flame, the potatoes will have to be watched constantly and each turned as soon as it has browned. If candied in the oven, the potatoes will

have to be looked at and turned only occasionally but will require about 15 minutes for browning.

If extra syrup for pouring over the vegetable is desired, add 2 to 3 tablespoons of water to the sticky mass that remains on the bottom of the pan after the potatoes have been removed and boil the mixture until it thickens.

b) Browning parsnips: Melt $1\frac{1}{3}$ to 2 tablespoons of butter in a frying-pan or other shallow pan. Place cooked parsnips in the butter; heat them over a low flame or in an oven at 500° F. until they become brown. When heated over a flame, the vegetable will have to be watched constantly and each piece turned as soon as it browns; when heated in an oven, it needs to be looked at and turned only occasionally but will require 15 or more minutes for browning.

TABLE 4

Quantities of Vegetables as Purchased and as Edible Portion for Four Servings, Approximately 2 Cups when Cooked

Vegetable	As Purchased			Edible Portion
	Approximate Weight		Approximate Measure	Raw
	ounces	grams		grams
Asparagus	18	500	$2\frac{1}{2}$ small bunches	300
Beans, green	$10\frac{1}{2}$	300	$\frac{4}{5}$ quart	255
Beets, with tops (young)	27	750	5 medium sized	400
Beets, without tops (old)	17	480		
Broccoli	12	325	$\frac{1}{2}$–$\frac{3}{4}$ bunch	300
Brussels sprouts	$10\frac{1}{2}$	300	$\frac{2}{3}$ of a quart box	240
Cabbage, green (loose head)	27	750	1 medium head ($5\frac{1}{2}$ inches in diameter)	450
Cabbage, white (compact head)	$9\frac{1}{2}$	270	$\frac{1}{3}$ medium head (5 inches in diameter)	240
Cabbage, red	$11\frac{1}{2}$	320	$\frac{3}{4}$ medium head	265
Carrots, with tops (young)	16	450	6 medium sized	325
Carrots, without tops (old)	14	400		
Cauliflower (as trimmed for the city market)	23	650	1 head (4–5 inches across)	325
Onions, white	18	500	6 medium sized (diameter about $2\frac{1}{2}$ inches)	440
Onions, yellow	19	525	6 medium sized (diameter about $2\frac{1}{2}$ inches)	440
Parsnips (without tops)	14	400	3 medium sized	300
Peas, green	$32\frac{1}{2}$	910	2 quarts (shelled, $2\frac{1}{2}$ cups)	350
Potatoes, Irish	$12\frac{1}{2}$	350	3 medium sized	300
Potatoes, sweet	13	370	3 medium sized	300
Rutabagas	21	580	$\frac{2}{3}$ medium sized (about 4 inches in diameter)	535
Spinach, with stems	$21\frac{1}{2}$	600	$\frac{1}{2}$ peck	570 (wet)*
Spinach, without stems	32	900	$\frac{3}{4}$ peck	
Squash, acorn	29	800	2 squash	480
Squash, Hubbard	29	800	About $\frac{1}{6}$ of a squash, about 11 inches in diameter	480
Squash, summer (Zucchini, yellow crookneck, patty pan)	17	475	5 small Zucchini, 1 yellow crookneck, or patty pan	450
Turnips, white (without tops)	16	450	3 medium sized	340

* The weight after washing and freeing from surface moisture equals 440 grams.

TABLE 5

Timetable for Boiling Vegetables in Portions Which Yield Four Servings, Approximately 2 Cups, when Cooked

Vegetable	How Prepared for Cooking	Weight of Prepared Vegetable To Cook*	Approximate Measure of Water To Use†		Capacity of Cooking-Pan‡	Time To Cook
		grams	cups	milliliters	quarts	minutes
Asparagus	Woody ends broken off and discarded, stems halved or quartered almost to the head (see Fig. 3)	300	3	700	3	10–15
Beans, green	Ends removed; beans cut into lengthwise strips	255	4	950	2	12–15
	Ends removed; beans broken into $1\frac{1}{2}$-inch pieces	255	4	950	2	20–30
Beans, wax	Ends removed; beans broken into $1\frac{1}{2}$-inch pieces	255	4	950	2	20–30
Beets (young)	Whole (not pared); 1 or more inches of stem left on	400	4	950§	$2\frac{1}{2}$	40–60
Broccoli	Woody ends broken off and discarded; stalks halved or quartered almost to the head (see (Fig. 3)	300	7	1,650	4	8–10
Brussels sprouts	Partially quartered (see Fig. 2)	240	5	1,200	3	9–10
Cabbage, loose head	Cut into strips about $\frac{1}{4}$ inch wide	450	5	1,200	3	6–8
Cabbage, compact head	Cut into strips about $\frac{1}{4}$ inch wide	240	5	1,200	3	8–12
Cabbage, red	Cut into strips about $\frac{1}{4}$ inch wide; cooked with 4–5 tart apples or 4–5 tablespoons of vinegar	265	5	1,200	3	20–25
Carrots	Scraped; cut into halves or quarters lengthwise and, if long, into halves crosswise	325	3	700§	$2\frac{1}{2}$	Young: 15–18 Old: 25–30

* For most purposes the amount of prepared vegetable obtained from the as-purchased weight or measure (see Table 4) may be used without further checking of the weight.

† Add 1–$1\frac{1}{2}$ teaspoons of salt for each quart of water and boil for 1–2 minutes before adding the vegetable.

‡ Top inside diameter: $5\frac{3}{4}$, $6\frac{5}{8}$, $7\frac{3}{8}$, $7\frac{7}{8}$, and $8\frac{3}{4}$ inches for the $1\frac{1}{2}$-, 2-, $2\frac{1}{2}$-, 3-, and 4-quart sizes, respectively.

§ Cover the pan.

TABLE 5—*Continued*

TIMETABLE FOR BOILING VEGETABLES IN PORTIONS WHICH YIELD FOUR SERVINGS, APPROXIMATELY 2 CUPS, WHEN COOKED

Vegetable	How Prepared for Cooking	Weight of Prepared Vegetable To Cook	Approximate Measure of Water To Use		Capacity of Cooking-Pan	Time To Cook
		grams	cups	milliliters	quarts	minutes
Cauliflower	Separated into flowerets	325	5	1,200	3	8–10
Onions, white	Peeled; partially quartered from bud end (see Fig. 2)	440	7	1,650	4	25–35
Onions, yellow	Peeled; partially quartered from bud end (see Fig. 2)	440	7	1,650	4	20–25
Parsnips	Pared; cut into halves lengthwise and into halves or thirds crosswise	300	3	700§	$2\frac{1}{2}$	25–30
Peas	Shelled	350	3	700	2	10–20
Potatoes, Irish	Pared; cut into halves lengthwise	300	4	950§	$2\frac{1}{2}$	25–30
Potatoes, sweet	Pared; cut into halves or quarters lengthwise	300	3	700§	$2\frac{1}{2}$	15–25
Rutabagas	Pared and cut into $\frac{3}{4}$-inch cubes	535	7	1,650	4	25–30
Spinach	Stems not removed	570 (wet)	3	700	3‖	8–10
	Stems removed	570 (wet)	5	1,200	3‖	4–5
Squash, Hubbard	Pared, and cut into pieces 2×3 inches	480	4	950§	3	20
Squash, summer (Zucchini, yellow crookneck, patty pan)	Cut into 1-inch cubes without paring or removing seeds unless skin is tough, in which case pare and discard large seeds	450	$1\frac{1}{2}$	350	$1\frac{1}{2}$	6
Turnips, white	Pared; cut into $\frac{3}{4}$-inch cubes	340	6	1,400	3	20–25

§ Cover the pan.

‖ This size of pan is convenient during cooking, but the spinach will have to be added in two or three portions.

Timetable for Cooking Vegetables in a Pressure Saucepan in Portions Which Yield Four Servings, Approximately 2 Cups, when Cooked

Vegetable	How Prepared for Cooking	Weight of of Prepared Vegetable To Cook*	Approximate Measure of Water To Use†		Time To Cook after Weight Is Placed on Cooker‡
		grams	cup	milliters	minutes
Asparagus	Woody ends broken off and discarded; stems halved or quartered almost to head (see Fig. 3)	300	$\frac{1}{4}$	60	$1-1\frac{1}{2}$
Beans, green	Ends removed; beans cut into lengthwise strips	255	$\frac{1}{4}$	60	$1\frac{1}{2}-1\frac{3}{4}$
	Ends removed; beans broken into $1\frac{1}{2}$-inch pieces	255	$\frac{1}{4}$	60	$2\frac{1}{4}-3$
Beans, wax	Ends removed; beans broken into $1\frac{1}{2}$-inch pieces	255	$\frac{1}{4}$	60	$2\frac{1}{4}-3$
Beets	Pared and sliced	400	$\frac{1}{4}$	60	6–8
	Whole (not pared); one inch or more of stem left on	400	$\frac{1}{2}$	120	15 (small) 30 (large)
Broccoli	Woody ends broken off and discarded; stalks halved or quartered almost to head (see Fig. 3)	300	$\frac{1}{4}$	60	$1-1\frac{1}{2}$
Brussels sprouts	Partially quartered (see Fig. 2)	240	$\frac{1}{4}$	60	2
Cabbage, loose head (green)	Cut into strips about $\frac{1}{4}$ inch wide	450	$\frac{1}{4}$	60	$1\frac{1}{2}-2$
Carrots	Scraped; cut into halves or quarters lengthwise and, if long, into halves crosswise	325	$\frac{1}{4}$	60	$2\frac{1}{2}-3$
Cauliflower	Separated into flowerets	325	$\frac{1}{4}$	60	$1\frac{1}{2}-2$
Parsnips	Pared; cut into halves lengthwise, and into halves or thirds crosswise	300	$\frac{1}{4}$	60	$2\frac{1}{2}-3$
Peas	Shelled	350	$\frac{1}{4}$	60	$\frac{3}{4}-1\frac{1}{4}$
Potatoes, Irish	Pared; cut into halves lengthwise	300	$\frac{1}{3}$	80	10–12
Potatoes, sweet	Pared; cut into halves or quarters lengthwise	300	$\frac{1}{3}$	80	8–9
Rutabagas	Pared; cut into $\frac{3}{4}$-inch cubes	535	$\frac{1}{4}$	60	4–6
Squash, Hubbard	Cut into pieces 2×3 inches; pared	480	$\frac{1}{3}$	80	6
Squash, summer (Zucchini, yellow crook-neck, patty pan)	Cut into 1-inch cubes without paring or removing seeds unless skin is tough, in which case, pare and discard the large seeds	450	$\frac{1}{4}$	60	2
Turnips, white	Pared; sliced	340	$\frac{1}{4}$	60	3–4

* For most purposes the amount of prepared vegetable obtained from the as-purchased weight or measure (see Table 4) may be used without further checking of the weight. For cooking this quantity of vegetable, a 2- or 3-quart saucepan should be used.

† Add $\frac{1}{2}$ teaspoon of salt to the water.

‡ As soon as the cooking period is over, set the cooker in a pan of cold water or let cold water run over it.

TABLE 7

Timetable for Cooking Vegetables in Tightly Covered Pan and Steamer in Portions Which Yield Four Servings, Approximately 2 Cups, when Cooked

Vegetable	How Prepared for Cooking	Weight of Prepared Vegetable To Cook*	Cooking in Tightly Covered Pan†			Time To Cook in Steamer
			Approximate Measure of Water To Use		Time To Cook	
		grams	cup	milli-liters	minutes	minutes
Beans, wax	Ends removed; beans broken into $1\frac{1}{2}$-inch pieces	255	$\frac{1}{2}$	120	40–50	50–60
Beets	Whole (not pared); 1 inch at least of stem left on	400	$\frac{3}{4}$	175	50–70	60–90
Carrots	Scraped; cut into halves or quarters lengthwise and, if long, into halves crosswise	325	$\frac{1}{4}$	60	Young: 20–25	25–30
					Old: 30–35	35–45
Parsnips	Pared; cut into halves lengthwise, and into halves or thirds crosswise	300	$\frac{1}{3}$	80	25–30	35–40
Potatoes, Irish	Pared; quartered	300	$\frac{1}{4}$	60	20–25	30–35
Potatoes, sweet	Pared; quartered	300	$\frac{1}{3}$	80	20–25	25–30
Spinach (young)	Stems removed	570 (wet)	0‡	0‡	12–18	12–18
Squash, Hubbard	Cut into 2-inch squares; pared	480	$\frac{1}{3}$	80	20–25	25–30
Squash, summer (yellow crookneck, patty pan)	Cut into 1-inch cubes without paring or removing seeds unless skin is tough, in which case, pare and discard the large seeds	450	$\frac{1}{4}$	60	10–12	15

* For most purposes the amount of prepared vegetable obtained from the as-purchased weight or measure (see Table 4) may be used without further checking of the weight.

† Bring the water just to boiling in the covered pan, quickly add $\frac{1}{2}$ teaspoon of salt and the vegetable and re-cover the pan, place over full heat until steam begins to escape around the lid, then over low enough heat that only wisps of steam escape from time to time.

‡ Use only the water clinging to the leaves.

TABLE 8

Timetable for Baking Vegetables in Portions* Which Yield Four Servings, Approximately 2 Cups, when Cooked

Vegetable	Temperature of Oven and Time of Baking
Potatoes, Irish	45–60 minutes at 425° F. for medium-sized potatoes
Potatoes, sweet	35–45 minutes at 425° F. for medium-sized potatoes
Squash, acorn	30–40 minutes at 425° F. for halves turned upside down on oiled pan
Squash, Hubbard	50–60 minutes at 425° F. for 3×4×1-inch pieces turned upside down on oiled pan

* For quantity to cook see "Approximate Measure," Table 4.

TABLE 9

Timetable for Cooking Frozen Vegetables in Portions Which Yield Four Servings, Approximately 2 Cups, when Cooked

Vegetable*	Weight of Frozen Vegetable To Cook	Boiling in Uncovered 2-Quart Pan			Time To Cook in Pressure Saucepan †
		Approximate Measure of Water To Use		Time To Cook after Water Returns to Boiling	
	ounces	cups	milliliters	minutes	minutes
Asparagus spears	12	2	473	6–10	1–1½
Beans, green (1-inch lengths)	10	1	237	9–14	2–3
Beans, green (French style)	10	1	237	6–10	2–2½
Beans, wax	10	1	237	9–14	2–3
Beans, lima	12	1	237	10–12	1½–2
Corn (cut off cob)	10	1	237	6–8	½–1
Peas	12	1	237	9–13	½–1
Spinach	14	2	473	9–11	2–3

* Keep frozen until ready to use, then tap the package of vegetable on the edge of the sink until the block has broken into a number of pieces, unwrap, and place the pieces immediately in the boiling water or pressure saucepan.

† Use ¼ cup (60 milliliters) of water in the pressure saucepan.

CHAPTER II

FACTORS WHICH CONTRIBUTE TOWARD SUCCESS IN THE PREPARATION OF MUFFINS, CAKES, BISCUITS, AND PASTRY

WHY do many of us find it hard to make two cakes in succession that are equally good? Why do we have trouble if we take half or double the simplest recipe? And why can we seldom, if ever, make an exact copy of a friend's favorite cake with her carefully written recipe right before us?

There are several possible answers, one of them being that we change the proportion of ingredients by our method of measuring, thus evolving an entirely new recipe, which as likely as not does not work.

That the proportion of ingredients is a matter of considerable importance is evident enough to anyone who has tried making cakes with either too little or too much flour. With too little flour, the cake froths to the top of the pan, perhaps over the top into the oven, and probably ends by falling flat. With too much flour, it rises to a peak and, on cutting, turns out to be bready and solid. In no way does either resemble the light, feathery, velvety product we look for in a cake.

The good old-fashioned cook seemingly slaps things together without rhyme or reason, yet usually turns out tiptop products. This is because she has acquired a sense—something which she cannot put into words and pass on—of how things should look and feel. Such a sense, however, is acquired only by long hours on the job, hours which the modern woman with her great variety of interests would prefer to spend elsewhere than in the

kitchen. For her a short cut is essential. She must learn, therefore, to know what factors contribute toward success and how to control them.

PROPORTION OF INGREDIENTS

MEASURING VERSUS WEIGHING

Obviously, the first essential is to have the same proportion of ingredients each time we use a given recipe. This is simple enough if we weigh our ingredients; but if we measure them, we run into difficulties.

In general, these measuring difficulties are of two sorts: those dependent on our manipulation of ingredients and those traceable to our measuring-utensils. These variables are so difficult to control that in home economics laboratories all comparative and research work in batters and doughs has long been done with weighed, rather than measured, ingredients. This, after all, is the safest, surest, and really the easiest way out of the difficulty and is doubtless the way which will be adopted by future generations of women with a scientific training. For such women, weighing presents no difficulties; and the only objection they might be disposed to raise against it is that it takes longer than to measure. This objection, however, cannot be sustained, as anyone can see for herself by comparing the time required for the two processes.

The quickest method of weighing is with spring balances such as those pictured in Figure 17. These weigh 500 grams by 2-gram divisions, which means that they can be used for weighing all materials save those used in very small quantities. To use these, one places a light-weight bowl, plate, or whatever is used as a container for the substance to be weighed, on the scale pan at the top, turns the dial until the hand indicates zero, then adds the material in question until the hands point to the required weight. Such balances as these may be obtained from Hanson Brothers Scale Company, Chicago.

The Harvard scale (Fig. 18) has a capacity of 5,000 grams (about 10 pounds) and a sensitivity of one-tenth of a gram for

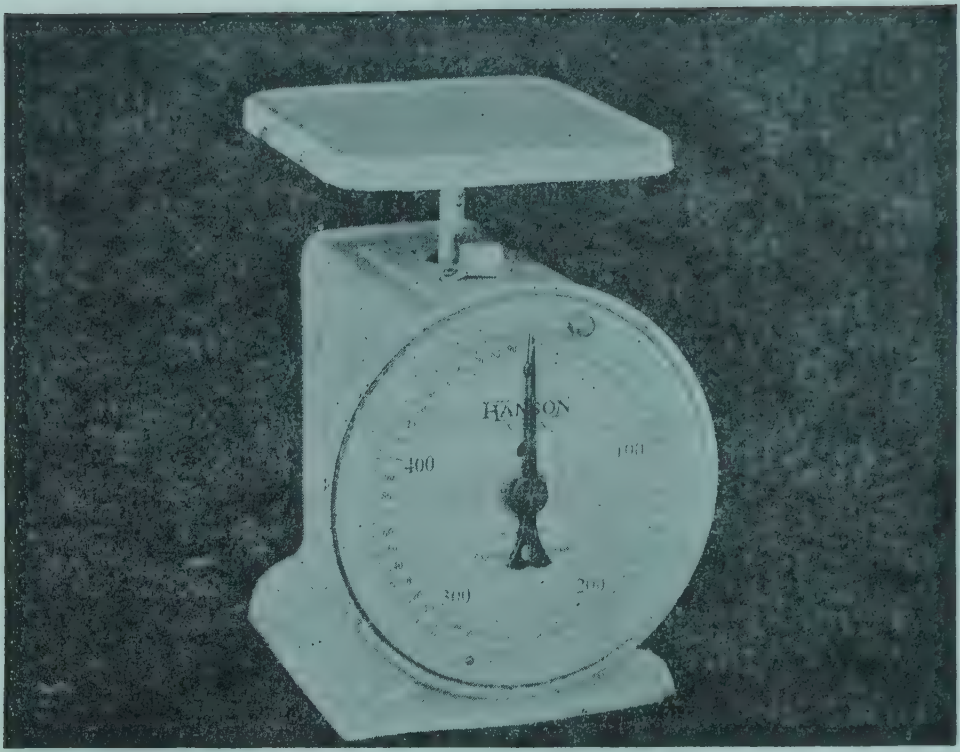


FIG. 17.—A spring balance. All ingredients, except those used in very small quantities, can be weighed easily and quickly on such a balance as this.

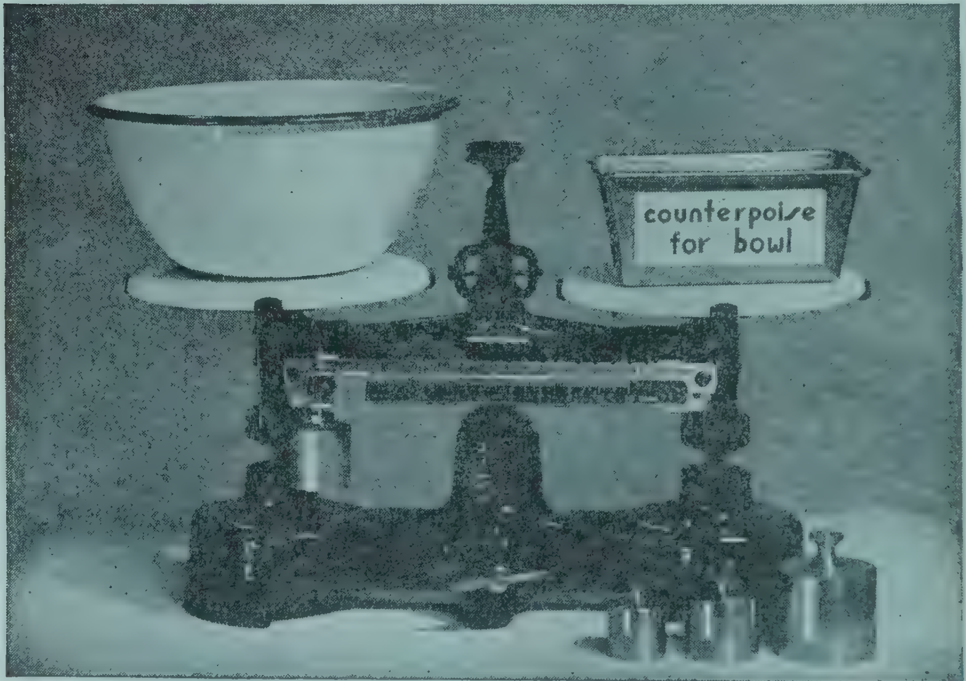


FIG. 18.—Harvard trip scale with counterpoised bowl. This balance can be used to weigh both larger and smaller quantities than can the type shown in Figure 17.

light loads, and hence has a wide range of usefulness. This scale can be used at a very little greater outlay of time than that required for the spring balance, if one sets aside certain dishes for weighing and provides each with a properly marked counterpoise. Such an arrangement is shown in Figure 18. Here we have on the left side of the balance a light-weight bowl of suitable capacity for weighing out flour and sugar, which is balanced with shot placed in the dish labeled "counterpoise for bowl." With two or three dishes thus counterpoised, weighing can be rapidly carried out simply by placing the required weights on the right side of the balance and adding enough flour, sugar, or whatever is being weighed to the dish on the left side to bring the balances to equilibrium again. The Harvard scale is carried by all scientific laboratory supply houses, such as the Central Scientific Company and E. H. Sargent and Company, both of Chicago.

Fats and small portions of all dry ingredients are most easily weighed on pieces of paper which can be counterpoised with other pieces of paper of the same kind and size. This is easy enough to manage if one keeps a small pad of glazed paper of suitable size near the balances and, when about to weigh, tears off two sheets, placing one on each of the balance pans. Various other devices for speeding up the process will, of course, occur to the person who undertakes to weigh in place of measure in order to eliminate her first great difficulty, which is to keep her proportions the same each time she uses a recipe.

Much as we favor weighing as against measuring—save for salt, flavoring, and certain other ingredients used in very small proportions—it will be noted that measures as well as weights are given in all our recipes. This is because we realize that, for the present, cooking in American homes is almost invariably done by measure; in Europe, we have been told, weighing is a common practice. Here, even those who teach cooking-courses and have their class work done by weight have a tendency to yield to their early habits and to cook by measure at home. Such being the case, we have given our proportions by measure as well as

by weight, hoping thereby to make our recipes usable to those who by choice or necessity still continue to measure.

We must state quite emphatically, however, that if the ingredients are measured, the method of procedure must be the same as we have used. Otherwise, these recipes will not give one whit better results than ten thousand others of their kind.

In order to justify our insistence on a certain procedure for measuring, we are giving in the pages that follow a rather full discussion of the facts upon which our conclusions regarding measuring are based.

VARIATION IN MEASURING DUE TO MANIPULATION

Liquids.—Liquids are apparently the easiest to measure, and one might suppose that if half-a-dozen people were asked to measure a cup of water or milk, using the same cup, all would measure very nearly the same quantity; but such is not the case. We have observed the measuring operations of some pretty good students, all with considerable scientific training, and have found that there is a general tendency to avoid filling the utensil full of liquid and, conversely, as will be discussed presently, to give extra good measure in solids. Another tendency observed is the failure to empty the utensil completely. If these same students were working with scientific apparatus, they would probably try to be scientifically exact; but cups and spoons have too long been associated with haphazard methods to call for exact work unless the consequences of carelessness are demonstrated.

With careful work, however, which means filling the cup to the proper graduation and emptying it completely, the difference in any number of measurements does not exceed 6 cubic centimeters, which is somewhat less than ½ tablespoon.

Fats.—In measuring fats, a real difficulty is encountered, and that is the tendency for large air spaces to form, especially when the fat is cold. With what was thought to be fairly careful work, using lard, which is plastic and easily packed, a cupful measured immediately after it was taken from the refrigerator was found

to be but 182 grams; whereas the same measure of this lard when allowed to come to the temperature of the room weighed 203 grams, which is the correct value. The difference of 21 grams between the two measurements assumes considerable significance when thought of as almost 2 tablespoons. Butter, being harder and less plastic than lard, showed an ever greater resistance to packing when cold, and a greater tendency to slip and slide around when one tried to pack it down into the utensil.

Another difficulty in measuring fats is the resistance to leveling off. If one is not careful, the top is still rounded after passing the spatula over it. A rounded surface would, of course, tend to compensate for air spaces and therefore might appear to be desirable in measuring cold fats; but, since no two cups of fat with air spaces and rounded tops are likely to weigh the same, it is better to pack solid and to level off the top to a flat surface.

The difficulty in measuring fats can be much lessened by taking the fat out of the refrigerator for a few minutes in hot weather, an hour or so in cold, before it is to be measured; but even then a special effort must be made to see that the pack is solid with no air spaces.

Flour.—The difficulties met with in measuring fat, however, are as nothing to those in measuring flour. If one really fills an accurate cup with fat and really levels off the surface, one has the correct quantity of that particular fat, with nearly the same degree of accuracy as though it had been weighed. But with flour there is no correct weight for 1 cupful—there is, to be sure, a more or less accepted value[1] which is rather generally used by those who cook by weight, but no absolute, standard one. A cup of the very same flour was, in fact, found to vary in weight from 96 to 134 grams, a difference of over 6 tablespoons, depending on how it was packed.

The thing to do, then, in measuring flour is to find that method of manipulation which will give the best checks and to stick

[1] *Handbook of Food Preparation* (Washington, D.C.: American Home Economics Association, 1946), pp. 29–32.

to it one's self and to describe it in detail when giving one's recipes to others.

Two methods of filling a cup were found to give very good checks. One was to sift the flour in small portions and then to fill the cup with a tablespoon, dipping the spoon into the flour gently, bringing it up heaping full, and putting it into the cup with almost as light a touch as though it were an explosive likely to blow up if jarred, then leveling off the top with the *edge* of a spatula—not the flat surface, for with it there is a tendency to use pressure. By this method the variation in the weight of any number of measurements of a given sample of flour need not run much, if any, higher than the equivalent of half a tablespoon per cup.

It may be stated that a cupful of once sifted flour weighs practically the same as a cupful sifted four or five times. There seems, then, no point in sifting it several times, as some of us have been accustomed to do in making angel cake. It is, however, very important that we sift it immediately before using, because flour which has been sifted for some time is very liable to be packed about as solidly as the unsifted. It is also important that the flour be sifted in small portions, not more than 2 or 3 cupfuls at a time. If enough flour is sifted at one time to fill a large bowl or pan, the portion in the lower part of the container will pack down so that a cupful taken from this part will weigh appreciably more than a cupful taken from the upper part.

Another satisfactory method of measuring flour is to sift it directly into the cup, filling the cup slightly overfull and leveling off the surface with the edge of a spatula. We have obtained slightly better checks by this method than by putting the flour into the cup with a spoon. The two methods, however, do not check, the flour sifted into the cup running about the equivalent of a tablespoon less per cup than that put in with a spoon. Thus it is important that in giving our recipes to other people we should tell just how we measured the flour. For convenience we have adopted the method of putting the once sifted flour into the cup with a spoon.

It is impossible, however, to get checks by dipping the cup into the flour or by tapping it to fill air spaces. Once one begins to pack, one does not know where to stop, nor is one likely to stop at the same place twice. Moreover, it would be impossible to describe the tapping method in such a way that it could be followed by anyone else.

Granulated sugar.—What has been said about flour applies also to granulated sugar, but not to the same extent. In other words, this sugar packs, but not so much as flour. The greatest difference in the weight of 1 cupful of a given sugar due to manipulation was found to be a little more than the equivalent of 2 tablespoons per cup, as against a difference of 6 tablespoons of flour. The best checks were obtained by measuring sugar by the same method as was used for flour, save that the sugar was not sifted before measuring. With this method the difference in weight of a number of measurements was equal to about one-fifth of a tablespoon.

Confectioner's sugar.—Confectioner's sugar is usually lumpy; hence it must be rolled and sifted before it can be measured. Like flour, it must be handled carefully to avoid packing. The weight of a given measure is very little more than half that of the same measure of granulated.

Brown sugar.—We have not been able to find any satisfactory method of measuring brown sugar. Our best checks were obtained by rolling the sugar to remove the lumps, then packing it solidly into the cup with a spoon. Measured thus, the weight of a given measure was approximately the same as that of the granulated.

VARIATION IN MEASURING DUE TO UTENSILS

Standards for measuring-utensils.—In the discussion just concluded we have assumed the use of cups of like capacity. The next question is: Are cups of standard capacity available, and, if so, will the manipulation just outlined work in filling the subdivisions?

In order to have all measuring-cups hold the same quantity, a standard has been chosen which is one-fourth of a liquid

quart, or 236.6 cubic centimeters. The capacity of a standard tablespoon is one-sixteenth that of 1 cup, of a teaspoon one-third that of a tablespoon. For convenience the capacities of cups and their subdivisions are given in tabular form in Table 10.

Conformity of measuring-utensils with the standard.—All measuring-cups and spoons are supposed to conform to this standard; but whether all of them do is an open question. Some years ago a large number of them did not. This was shown by a survey of forty-eight different measuring-cups—tin, glass, aluminum, and enamelware—which were collected from thirty-three manufacturers. These cups were tested at the Bureau of Standards to see how nearly they approached the correct standard for capacity. Concerning these cups the report stated:

TABLE 10

CAPACITY OF STANDARD MEASURING-UTENSILS

	Cubic Centimeters or Milliliters
1 cup	236.6
¾ cup	177.4
⅔ cup	157.7
½ cup	118.3
⅓ cup	78.9
¼ cup	59.2
1 tablespoon	14.8
1 teaspoon	4.9

> It was found that half of the cups showed errors from 5 per cent to 25 per cent above or below the standard. The largest cup held almost 50 per cent more than the smallest. The errors in subdivisions, such as half-cups, third-cups, etc., were proportionately greater as the fraction measured grew smaller. Twenty-one of the forty-eight cups tested had the lowest quarter cup division so marked that it held from 10 per cent to 33 per cent too much or too little. The largest of the quarter cups as marked held almost twice as much as the smallest.[2]

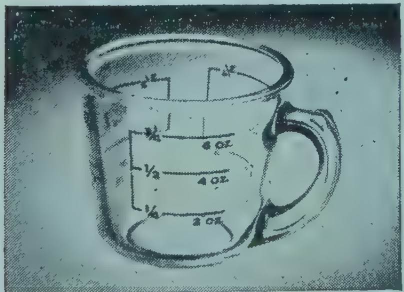
It appears, then, that a measuring-cup may be just about on a par with the good old-fashioned teacup as an instrument of pre-

[2] "Housekeepers Vote for Standard Measures," *Good Housekeeping*, April, 1925, p. 80.

FIG. 19.—Laboratory cups used in measuring the flour for Table 11

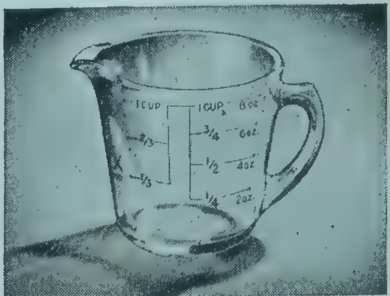
Courtesy of Ecko Products Company

FIG. 20.—Individual cups for measuring 1, $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ cup



Courtesy of Corning Glass Works

FIG. 21.—Glass cup for measuring solids.



Courtesy of Corning Glass Works

FIG. 22.—Glass cup for measuring liquids.

cision. It behooves us, therefore, to test the ones we have and, if they show inaccuracies, to purchase better ones. Some of those that we have tested and found satisfactory are the aluminum cup put out by the makers of Swans Down cake flour; the Pyrex glass cups, one for dry, the other for liquid measure, shown in Figures 21 and 22; and the metal cups of Figure 20. Undoubtedly, there are others quite as satisfactory.

Fortunately, it is easy enough to determine whether or not the cups we are using are of standard capacity, simply by measuring into them from a graduated cylinder the quantity of water they are supposed to hold. Thus the whole cup should hold 236.6, the half-cup 118.3, cubic centimeters of cold water. Another way to test the capacity is to find out if 4 cups of liquid measured in these cups will just fill a standard 1-quart measure.

If we care to take the trouble, we can also check the accuracy of the subdivisions of any cup in a roundabout way by finding out if two of the half-, three of the third-, and four of the quarter-cup measures of liquid really do fill the whole cup. If two similar cups are not available, the measured portions of liquid can be poured into any utensil and then turned back into the cup being tested; and, if it is just filled and no more, one may conclude that the graduation marks are correctly placed and that they are of suitable width, length, and distinctness. Otherwise, one would not have been able to make the two, three, or four similar measurements required for the check.

Measuring in subdivisions of a cup.—If the graduations of a measuring-cup are distinct and correctly placed and if the cup is made of glass,[3] measurements of fractional cups of liquids can be carried out about as accurately and speedily as of whole cups; but solids are bound to give trouble. Fats, which in small-quantity cooking we so frequently want to measure in quarter- and third-cup portions, are particularly troublesome. It is hard to pack a lump of slippery fat into the bottom of a cup, more

[3] If such a cup is not available, we advise the use of a graduated cylinder for liquids, preferably one holding 100 cubic centimeters and costing about 65 cents, which can be purchased from any supply house for scientific apparatus.

especially one with straight sides; and it is still more difficult to level off the top. Not only that, it is time-consuming. So much is this the case that we doubt if small portions of fat are very frequently measured with any degree of accuracy in a cup.

Flour is just about as troublesome to measure in small portions as is fat, chiefly because of the difficulty of leveling off the surface without packing. Moreover, in measuring flour in subdivisions of cups, one has an almost irresistible desire to start tapping the cup to bring the surface of the flour on a level with the graduation. As we have already seen, this is fatal to accurate measurement. And so it appears that we shall have to be much more careful in measuring solids in subdivisions of cups than in whole cups. Little inconsistencies here are particularly troublesome in doubling recipes, such, for example, as one requiring $1\frac{1}{4}$ cups of flour. If we do not use extreme care in measuring, the $2\frac{1}{2}$ cups measured will be nothing like an exact double of the $1\frac{1}{4}$ cups.

One way out of the difficulty is to measure with spoons, using those which are accurately calibrated, such as the ones that come in the cakemaking set put out by Igleheart Brothers, Evansville, Indiana, manufacturers of Swans Down cake flour. To measure flour or sugar thus, dip the spoon into the material (sifted, if flour), bring it up rounding full, and level off the surface with the edge of a spatula. This method of measuring gives good results but is laborious.

Better than spoons or even the best of graduated cups are individual utensils for fractional parts of cups. These can be used equally well for liquids and solids and make the measurement of small portions no more difficult than of large. Such utensils are shown in Figure 19. These we had made at considerable expense by a laboratory technician in collaboration with a scientific supply house before sets were available commercially. By using these utensils with the precautions just specified, we were able to make our measurements of fractional parts of cups of solids agree very closely with the computed value. That is to say, if a cup of a given flour weighs 96 grams, a third of a cup

should weigh 32 grams; and this it did very nearly when measured in our cups, as is shown by Table 11. It was found also that the time required for measuring small portions of solids could be greatly reduced by using these small individual utensils. This was true for all solids but was particularly noticeable for fats.

Those of Figure 20 are manufactured by the Ekco Products Company of 1949 North Cicero Avenue, Chicago. They are widely distributed under the brand name "Mary Ann" and sell for 35–40 cents.

TABLE 11

COMPARISON OF COMPUTED AND ACTUAL WEIGHTS OF FRACTIONAL PARTS OF A CUP OF FLOUR

Student	1 Cup (Grams)	½ Cup		⅓ Cup		¼ Cup	
		Computed (Grams)	Actual (Grams)	Computed (Grams)	Actual (Grams)	Computed (Grams)	Actual (Grams)
G. V.	93.4	46.7	46.1	31.1	31.7	23.3	23.2
F. J.	92.6	46.3	46.1	30.9	32.8	23.2	22.9
V. W.	94.1	47.1	47.0	31.4	31.5	23.5	23.0
I. N.	93.6	46.8	46.6	31.2	32.8	23.4	23.3

SUMMARY OF MEASURING

Manipulation.—If cups or other utensils are correctly calibrated, we can check closely our own and each other's measurements by the following method of manipulation, provided we all use cups of like capacity.

a) Liquids: Fill the cup to the graduation mark if there is one, if not, to the brim. Empty it completely by tapping to dislodge the last clinging drops.

b) Fats: Pack the fat into a solid mass, being careful to press out all air spaces. Level off the top with *edge* of a spatula. The packing and leveling will be much easier to do if the fat is allowed to stand outside the refrigerator for an hour or so in winter and for a few minutes in summer.

c) Flour: Use recently sifted flour. Flour sifted several days

previous to measuring may be as solidly packed as though it had not been sifted at all. Dip up heaping tablespoons of the flour and place them lightly in the cup, filling it slightly to overflowing without the least jarring or tapping, and level off the surface with the edge of a spatula; or sift the flour directly into the cup, filling it slightly overfull, and then level off the surface with the edge of a spatula. The second method of measuring averages about the equivalent of 1 tablespoonful less per cup than the first.

d) Granulated sugar: Use the same process as for measuring flour, save that the sugar need not be sifted before measuring.

e) Confectioner's sugar: Spread the sugar on the molding board and roll it with the rolling pin to remove lumps; then sift and measure by the same process as for flour. Measured thus, $1\frac{3}{4}$ cups of confectioner's sugar is the approximate equivalent of 1 cup of granulated sugar.

f) Brown sugar: Roll out the lumps and measure by packing solidly into a cup, using a spoon to press it down. Measured thus, the weight of 1 cup of brown sugar will show variation but will approximate that of 1 cup of granulated.

Utensils.—A standard capacity for measuring-cups has been chosen, and one should make sure that the cups used conform to this standard both in their total capacity and in their subdivisions.

The measurement of solids in the subdivisions of cups is difficult and time-consuming, even if the graduation marks are distinct and accurately placed. If accurate individual utensils for the fractional parts of cups are not available, measurement of small portions of liquid should be made in a graduated cylinder; of solids, in accurately calibrated spoons.

INGREDIENTS

Assuming that we have our measuring operations so well controlled that we can be fairly certain to measure the same quantity of a given ingredient from time to time—or, better, that we weigh all the troublesome ingredients—what happens if

we substitute one ingredient for another? Suppose, for example, that we use general-purpose flour when the recipe calls for cake flour; water in place of milk, or vice versa; or that we replace one type of baking powder with another, Royal for Price's, or the other way around, will our results be equally good in all cases? In other words, can we say that a cup of one kind of flour will do the same work as a cup of any other kind and that a teaspoon of baking powder is a teaspoon of baking powder and that is all there is to it?

The answer is "No." When we begin to substitute in a recipe, we must also begin to modify it, a performance easy enough perhaps for an experienced cook but a hazardous undertaking for the inexperienced one with whom we are here chiefly concerned.

In order to make this point clear, let us review briefly some of the things which are known about baking powder and flour, the ingredients most likely to give us trouble if we substitute one type for the other without suitable modification of the recipe.

BAKING POWDER

There are three general types of baking powders on the market, all containing baking soda to furnish the carbon dioxide which leavens the dough; an acid to react with the soda and make it give up its carbon dioxide; and starch or starch and calcium carbonate to act as a dehydrating agent and thus prevent premature reaction of the powder in the can, also to act as a standardizing agent and bring the gas yield of the powders to the desired level.[4] Each powder is named according to its acid-reacting component. When the acid is cream of tartar or cream of tartar plus tartaric acid, we have a tartrate powder, of which Royal and Schillings are the best-known brands. Another distinct type of powder has an acid phosphate of calcium as the acid component, and therefore gets the name of a phosphate powder. Of this type there are two modifications on the retail

[4] For the chemistry of baking powders see E. G. Halliday and I. T. Noble, *Food Chemistry and Cookery* (Chicago: University of Chicago Press, 1943), pp. 208–10.

market. One of these contains the hydrate of monocalcium phosphate. Examples of this powder are Dr. Price's and Rumford's. The second modification is a comparative newcomer in the field. It is a heat-treated anhydrous form of the monocalcium phosphate, which is less soluble than the hydrate and thus slower in liberating gas. In addition, its particles are so prepared as to have a protective covering, which further slows its rate of reaction. Happy Family and a powder put out by the Jewel Tea Company are of this kind.

There is still another widely distributed type of baking powder, and that is the one containing two acid ingredients, hydrated monocalcium phosphate—the same as used in Price's and Rumford's—and sodium aluminum sulphate, frequently abbreviated to S.A.S. This last-named ingredient is not in itself an acid, but it yields an acid on hydrolysis. Since this hydrolysis is slow and incomplete in the dough before heat is applied, powders containing both the phosphate and the sulphate are frequently designated as "double-acting," one reaction taking place largely in the cold, the other in the oven. Two well-known brands of this type are Calumet and KC. In the latter, part of the starch is replaced by calcium carbonate, a substance which has sufficient neutralizing value to take care of the acidity of sour-milk products without the addition of soda and which also makes a contribution to the calcium requirement of the diet.

A comparison of the rate at which the various powders liberate carbon dioxide in one type of dough, that for doughnuts, is given in Table 12. In other types of dough the rate would undoubtedly be somewhat different, but the order would be the same. Thus the S.A.S.–phosphate would be slow throughout, and the anhydrous phosphate would be slow at first but would gain speed and tend to catch up to the hydrated phosphate and tartrate, which are fast from the start. Since much of the gas formed in a dough is lost on stirring, it follows that one should work quickly when using the fast-acting powders, whereas with the slow-acting ones less speed is required.

The various powders differ also in the nature of the com-

pounds formed as a result of the reaction between soda and the acid. These compounds have been found to have some action on the other components of the dough,[5] but not enough work has been done to make any practical application possible.

To avoid confusion, the facts just stated have been summarized in Table 13. Brands of powder not given in this table can be classified by consulting the label on the can, where the name of the acid ingredient which fixes the type will be found.

Considering the difference in the behavior of the powders and in the nature of the salts formed, it is at once evident that we

TABLE 12

CARBON DIOXIDE LIBERATED FROM BAKING POWDERS IN A DOUGHNUT DOUGH*

Acid-Reacting Component	Cubic Centimeters of Carbon Dioxide				
	2 Min.	4 Min.	6 Min.	8 Min.	14 Min.
Cream of tartar†	80	94	102	108	120
Hydrated phosphate	110	118	120	121	123
Anhydrous phosphate	32	55	94	110	118
S.A.S.–phosphate	52	60	62	64	68

* R. A. Barackman, "Chemical Leavening Agents and Their Characteristic Action in Doughs," *Cereal Chemistry*, VIII (1931), 423–33; also personal communication, September, 1945.

† If tartaric acid, in addition to cream of tartar, had been used in this powder, the reaction would have been as fast as, perhaps even faster than, the reaction of the hydrated phosphate.

cannot use different types interchangeably without making certain changes in our recipes. This is more true for cakes than for muffins and biscuits. In general, these changes are concerned with the proportion of powder and the optimum beating-time, which will be stated specifically in each recipe. If these recipes are followed, it will be found that perfectly good products can be made from all types of powders.

FLOUR

By far the greater proportion of white flour on the retail market in the United States may be classified as "all-purpose" or

[5] Florence C. Smith and C. H. Bailey, "The Effects of Chemical Leavening Agents on the Properties of Bread," *Journal of the American Association of Cereal Chemists*, VIII (1923), 183–94.

"family" flour, so called because it can be used to make all sorts of products from yeast bread to cake. In spite of the common classification, however, different brands, or sometimes even the same brand, may have quite different properties when purchased in different localities, owing, as will be explained later, to the characteristics of the wheat from which the flour is made.

TABLE 13

SUMMARY OF STATEMENTS REGARDING BAKING POWDERS

Type of Powder	Acid Component	Some Well-known Brands	Order of Reaction in the Dough	Soluble Compounds Formed Which Remain in the Baked Product
Tartrate	Cream of tartar and tartaric acid	Royal* Schilling	1 2	Potassium sodium tartrate and sodium tartrate
	Cream of tartar	No commercial brand†		Potassium sodium tartrate
Phosphate	Monocalcium phosphate, hydrate	Rumford's, Davis' Phosphate Dr. Price's	3	Disodium phosphate
	Monocalcium phosphate, anhydrous	Happy Family Jewel Tea Co.	4	Disodium phosphate
S.A.S.–phosphate (sulphate-phosphate)	Monocalcium phosphate and sodium aluminum sulphate	KC Calumet Davis' O.K. Clabber Girl	5	Sodium sulphate and disodium phosphate

* In some parts of the South, a S.A.S.–phosphate powder has been put out under the Royal brand.

† Sometimes made at home by using two measures of cream of tartar to one of baking soda.

Much of this family flour has been enriched, which means that there have been added to it three vitamins—riboflavin, thiamine, and niacin—and one or two minerals—iron and sometimes calcium—in approximately the proportions in which they occur in whole-wheat flour. Quite a bit of this flour, perhaps 15 per cent, has monocalcium phosphate, mostly the anhydrous variety, added to it. Such flour is designed especially for use with soda and sour milk in the preparation of hot biscuits. The phosphate, being an acid, will neutralize any excess soda that may be used and thus prevent discoloration and the develop-

ment of an unpleasant flavor. An even greater proportion of family flour, probably about 18 per cent, has soda, monocalcium phosphate (usually in the anhydrous form), and salt added to it in the proportion required for baking. It is therefore self-rising and is designated as such.

In addition to all-purpose flours, there is an appreciable quantity of a type prepared especially for cakes, a small percentage of which is self-rising.

Flours differ from one another chiefly in the quantity and quality of the proteins which they contain. These differences can be shown to a certain extent by mixing equal weights of samples of different types of flour with water and then washing out the resulting proteinaceous substance, called "gluten," under standard conditions.[6,7] Briefly, this washing process consists in making a stiff doughball, which is allowed to stand under water for a certain length of time and then kneaded under running water over a bolting-cloth sieve until all the starch is removed and the gluten is left behind as an elastic ball. If a comparison is made among gluten balls prepared from all-purpose and cake flours obtained from different parts of the United States, it will be found that they fall into three more or less distinct groups with regard to volume, weight, and consistency. The largest and most elastic gluten balls will be produced by some of the all-purpose flours, the intermediate ones by others of this type, and the smallest and least-elastic by the cake flours. The glutens from all flours, however, are elastic, as can be shown by stretching them with the fingers or, better still, by baking them in a hot oven, whereupon they will be found to expand to many times their original volume. Figure 23 shows the relative volumes of the wet and baked glutens washed from 25 grams each of a high-gluten, all-purpose flour and a cake flour, which, though chosen at random, are

[6] Albert E. Leach, *Food Inspection and Analysis* (4th ed.; New York: John Wiley & Sons, Inc., 1920), p. 331; D. B. Dill and C. L. Alsberg, "Some Critical Considerations of the Gluten Washing Problem," *Cereal Chemistry*, I (1924), 222–46.

[7] In mills and bakeries, gluten washing has been superseded by official baking tests.

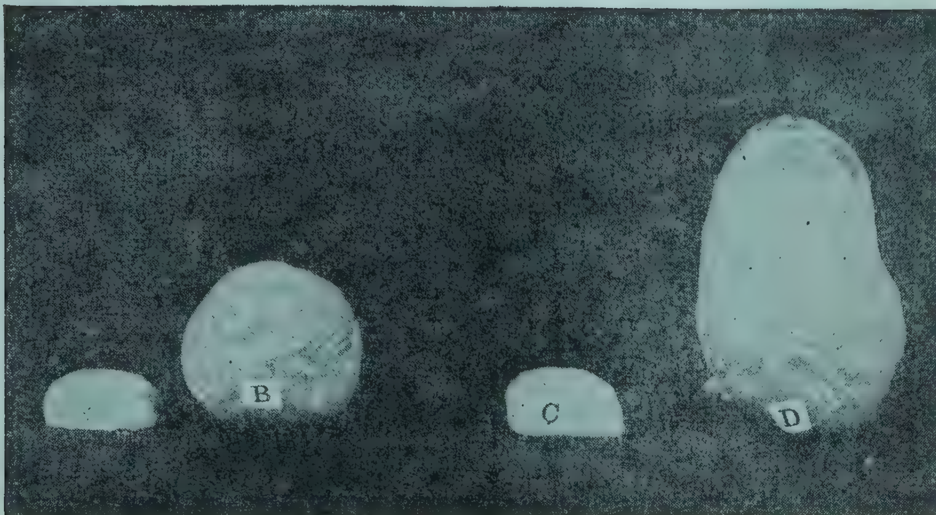


FIG. 23.—Wet (*A*) and dry (*B*) gluten from 25 grams of cake flour; wet (*C*) and dry (*D*) gluten from 25 grams of family or general-purpose flour. Glutens from the two types of flour differ both in quantity and in quality.

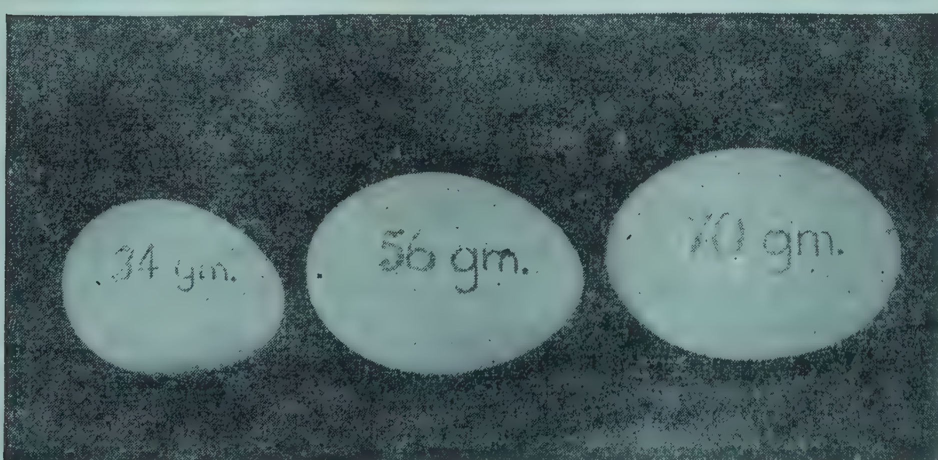


FIG. 24.—Eggs showing a possible difference in size. The largest weighs more than twice as much as the smallest.

fairly representative of such other samples of the two types of flour as we have examined. The weights of the two glutens before baking were 6.5 and 9 grams, or 26 and 36 per cent, respectively, of the weights of the flours used.

The difference in protein content and physical characteristics of flours is due to the kind of wheat and the part of the kernel from which the flour is prepared and also to the special treatment the flour receives in the milling process. A high-protein, all-purpose flour is made from hard winter wheat or a mixture of hard winter and hard spring wheat, both of which are high in the gluten-yielding proteins. This is the kind of all-purpose flour sold in the north central and northeastern regions of the United States. An all-purpose flour intermediate in protein content is made from soft or semihard wheat, the protein contents of which are lower and of somewhat different properties than that of hard wheat, or of a blend of the two. This is the principal kind of all-purpose flour sold in the southern and Pacific Coast regions. It is also the kind to which phosphates or leavening agents are usually added.

Cake flours are made entirely from soft wheat. They come from a more starchy part of the kernel than do soft-wheat general-purpose flours and are subjected to a special bleaching process which has a softening effect on the protein and which, it may be added, tends to lower the pH value of the flour, in other words to increase its active acidity. Both of these changes improve the cakemaking properties of the flour.

The protein content of a flour largely, if not entirely, determines its moisture-absorbing capacity. The marked difference that may exist in this property can be demonstrated by weighing given portions (100 grams, for instance) each of a high- and a low-protein flour of the same moisture content and adding slowly to each exactly the same volume of water (50–60 milliliters, for example), then working the two mixtures into doughs. If the amount of water used is just enough to make a good smooth dough with the high-protein flour, it will make a soft, sticky one with the low-protein sample. Conversely, if the

low-protein flour dough is just right, the one with the high protein will be exceedingly stiff and not at all smooth and elastic.

If the same flours are compared by measure—say, a cupful of each—it will be found that the high-protein sample will weigh more than the low-protein one. Even flours of the same type may show considerable variation. Thus Grewe,[8] who weighed many samples of soft-wheat flour, found the weight of a cupful to be anywhere from 80 to 99 grams—a difference of 19 grams, which is something over 3 tablespoons. Similar differences were observed for hard-wheat flours. Fortunately, however, such of the widely distributed brands as we have had an opportunity to work with seem to have been standardized so that the weight of 1 cupful is about the same: the hard-wheat, all-purpose ones around 113 grams per cup and the soft-wheat, all-purpose and cake flours around 96 grams.

The difference in moisture-absorbing capacity and weight per unit of measure give trouble in changing from one flour to another in a given recipe, particularly in one for biscuits. For these, as will be discussed later (p. 139), a large part of the success of the process consists in obtaining a dough of a certain consistency. Obviously, if one flour absorbs much more liquid per unit weight and weighs more per cup than the other, we cannot use the same measure of the two for a given volume of liquid. Provided we have the right proportions, however, it does not seem to make any difference which type of flour we use for biscuits, or for muffins and piecrusts; but specially milled soft-wheat flours help in producing velvetiness in the light, tender variety of cakes.

We have been able to make baking tests on but a few of the many brands of flour on the retail market. Of these, a number gave equally good results when used in the same proportion by either weight or measure; a few others did not. Of the latter, we have made no attempt to find what proportion, if any, would

[8] "Variations in the Weight of a Given Volume of Different Flours. I. Normal Variations," *Cereal Chemistry*, IX (1932), 313.

give good results. The following are the ones we have used successfully:

a) Hard-wheat family (all-purpose) flour: Gold Medal Kitchen Tested Flour; Pillsbury's Best XXXX Flour, sold in north central and southern United States

b) Soft-wheat family (all-purpose) flour: Ballard's Obelisk Flour; White Lily Flour.

c) Cake flour: Swans Down, Softasilk, Airy Fairy, Sno Sheen

For all we know, there are hundreds of other brands which would have given us equally good results had we tried them; therefore, we hesitate to single these out for special preference. Our reason for doing so is to help the inexperienced person, with whom, as already stated, we are chiefly concerned. We suggest that such a person choose one of the flours we have mentioned and use it until she is sure of her technique, because in this way she can eliminate one source of difficulty by using the proportion of ingredients we have worked out. She can depend upon them, since the flours listed have similar properties from season to season and from year to year, when purchased in the same vicinity. Afterward, if she wishes, she may experiment with such other brands as may be obtained conveniently in her own neighborhood. This very thing was done in our laboratory. A young woman who was able to make excellent cakes with one of the flours we used, tried two others. With one, her cakes were a failure; with the other, they were first class. The flour which gave the good cakes, it happened, was an inexpensive one produced in her own vicinity.

EGGS

Attention should be called to the difference which exists in the size of eggs. This is so great that one large egg may easily be the equivalent of two small ones. Thus, in the eggs shown in Figure 24 the smallest weighs 34 grams and the largest 70 grams in the shell, or about 30 and 62 grams, respectively, without the shell. The weight chosen for one egg in our recipes is 48 grams

after the shell has been removed, which is approximately the value accepted by home economics workers for a medium-sized egg. This weight is slightly less than the average of No. 1 eggs as graded for the city of Chicago market.

Weighing eggs in the shell and taking those which weigh about 55 grams is sufficiently accurate for ordinary purposes. If several eggs are used, there can be considerable variation in size and yet have the average around 55 grams. Weighing yolks and whites separately is a more accurate method and should be followed for experimental work. Without weighing, uniform results can be obtained only if one is a good guesser and can tell by the appearance of an egg whether it should be classed as large, small, or medium sized.

Any appreciable change in the quantity of egg used in baked products should be accompanied by an adjustment in the quantity of liquid, flour, and fat. What this adjustment should be we shall not attempt to say but will refer the reader to an article on the subject by Child.[9]

MANIPULATION OR METHOD OF COMBINING INGREDIENTS

In order to find to what extent baking failures are traceable to manipulation, we have made a large number of cakes, muffins, and biscuits in which the method of combining the ingredients was, so far as we know, the only variable. This was accomplished by using the same proportions throughout for each product, taking all ingredients from the same supply, weighing everything that was used, and baking all at a given temperature.

In every case we found that the way we combined our ingredients could either make or mar the product. For example, equal weights of the very same flour, same milk, same baking powder, same everything, gave the light, fluffy muffin shown in Figure 31 or the soggy, misshapen, tunneled one of Figure 32, depending on whether we stirred only enough to dampen the dry ingre-

[9] "Proportions of the Ingredients in Batters and Doughs," *Journal of Home Economics*, XVIII (1926), 157.

dients or whether we did a little extra stirring. Judging from our results, we conclude that for each type of baked product—indeed, for each recipe—there is at least one, maybe several, satisfactory methods of combining the ingredients, and most certainly any number of unsatisfactory ones. The methods given here are the ones the writers have found best of all that were used, and they are the only ones which we care to recommend. We can vouch for them, however, only when one uses the ingredients specified in the amounts designated and bakes at the temperatures suggested.

Right here we should like to state that we have found that our manipulation is conditioned by the utensils used—their shape and, for a given quantity of material, their size. For all types of batters and doughs we much prefer a porcelain or heavy glass bowl with a slope similar to that shown in Figure 25. Such a bowl is heavy enough to keep its position and not slide around with the slightest touch, and it has a slope which makes effective stirring possible. Moreover, it is easy to turn out batters or remove doughs from such a bowl. Bowls with a slope more nearly approaching the perpendicular, especially those with a sort of trough at the bottom, like that in Figure 26, are particularly exasperating to use. The sides come in so close that they hamper one's movements in stirring and decrease one's speed in removing the batter or dough.

The kind and shape of spoon used also make a difference in the manipulation of ingredients. Metal spoons bruise the hand and make effective stirring difficult; hence wooden spoons should be used. We prefer light-weight ones with very shallow bowls.

No matter how favorable the shape of the bowl and stirring spoon, however, we find we cannot stir in our accustomed way (that is, the way which gives us good results) if the bowl is more than half-full when all the ingredients are in it, in other words, if the depth of the batter is more than two-thirds that of the bowl. If the bowl is fuller than this, we have to stir carefully to prevent flour or liquid, maybe both, from spattering out of it,

FIG. 25.—A convenient mixing bowl. The advantages of this bowl are (1) the sloping sides which round gradually into the bottom, thereby making effective stirring possible, and (2) the weight, which is sufficient to keep the bowl from turning with every movement.

FIG. 26.—An inconvenient mixing bowl. The disadvantages of this bowl are the light weight and the straight sides, which, together with the trough at the bottom, make effective stirring difficult.

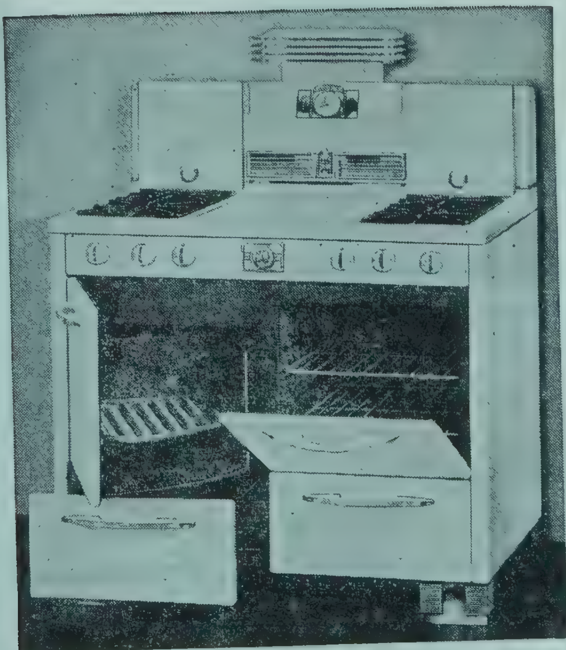
with the result that we change our usual procedure altogether and with it the character of the finished product. We have, it will be noted, stated for each recipe the size of the bowl we have found most convenient to use.

OVEN TEMPERATURES

With our carefully made product safely in the tin, we have still one more chance to spoil it in the baking. Take cakes, for example: If the oven is too hot, the top crusts over before the cake has risen sufficiently (in other words, while gas is still forming and expanding), with the natural result that the cake cannot rise any more until the interior pressure becomes great enough to break the crust at its weakest point, which is near the center. When this happens, the dough is forced out of the cracks in unsightly ridges. If the oven is not hot enough, the walls of the gas pockets apparently do not stiffen in time to prevent their being stretched beyond their holding capacity, with the result that they break and the cake is very coarse and tends to shrink.

Similarly with other products, the temperature of baking is a most important matter and varies with the ingredients used. Gingerbread, for example, with its large proportion of molasses, would be likely to scorch on the outside before the inside was done if baked at the temperature recommended for the ordinary butter cake. The optimum baking temperatures, however, have been fairly well worked out, so that no one need fail to know what temperature she should have for a given product. The difficulty is in getting and maintaining such a temperature, unless one has an oven equipped with a heat-regulator, as are the baking ovens of the gas stoves shown in Figures 27 and 28. These two stoves and others can be obtained with glass panels in the oven doors. Such panels are of considerable advantage to the beginner, for with them the whole baking process can be followed.

Oven-regulators, one style of which is shown in Figure 29, are generally reliable and can be depended upon to maintain



Courtesy of American Stove Company

FIG. 27.—A gas stove with a convenient swing-out broiler.

Courtesy of American Stove Company

FIG. 29.—A close view of the regulator with which the ovens of Figures 27 and 28 are equipped.

Courtesy of American Stove Company

FIG. 28.—A two-unit gas stove suitable for a food laboratory.

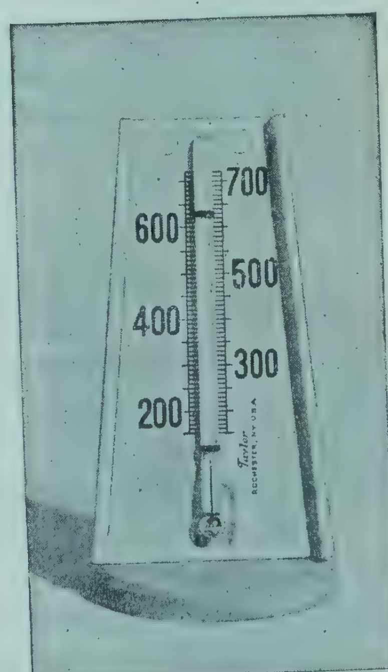


FIG. 30.—A mercury thermometer by which oven temperatures may be gauged. The one shown here is calibrated to read degrees Fahrenheit.

any desired temperature in baking. Like everything else, however, they may get out of order in time; hence for careful work we find it advisable to check them with mercury oven-thermometers similar to the one shown in Figure 30. Such thermometers are manufactured by the Taylor Instrument Companies, Rochester, New York. They may be obtained from the manufacturers, from any supply house for scientific apparatus, and also from many hardware dealers, at a cost of about $2.25. Those having a white background are easier to read than those with colored backgrounds.

In checking oven-regulators with Taylor thermometers, one must see to it that the thermometer itself is in good condition, for thermometers, too, may get out of order. One way to test them is to check one against another; a second way is against the boiling-point of water. The procedure for the first is to place two Taylor thermometers side by side in the center, and by "center" we mean a position equidistant from the top and bottom, as well as from the sides and back and front, of an otherwise empty oven. If, and only if, the two Taylors agree and register a temperature higher or lower than that for which the regulator was set, do we assume that the regulator is at fault and send for a repair man to come and readjust it. For the second method of testing, the thermometer is set in a pan containing enough water to come to about the 300° F. mark, the water heated to boiling, and the thermometer read while it stands in the boiling water. If it reads anywhere between 200° and 220° F., we consider it satisfactory for our purpose.

If one must use an oven not equipped with a heat-regulator, particularly one heated by coal or wood, learning how to bake is a tedious process, which may be much simplified, however, by use of a mercury oven-thermometer.

No matter how we regulate the heat, it should be realized that no oven will give its best service if overloaded. Moreover, when several pans are put in an oven at the same time, they should be so placed that they are not directly over one another and also so that they do not touch each other or the edge of the

oven. When only one is in the oven at a time, its center, of course, should be placed as near the center of the oven as possible.

The baking temperatures given in the recipes which follow are the ones we have found most satisfactory; and we feel certain they will give good results, provided the directions have been followed in choosing, measuring, and combining the ingredients.

REMARKS CONCERNING THE ARRANGEMENT AND USE OF THE DIRECTIONS FOR COOKING

What has been said thus far about batters and doughs applies equally well to all members of the series; what comes next is specific for each product considered—muffins, cakes, biscuits, and pastry—a chapter being devoted to each.

The material in these chapters consists of a description of what we consider a standard product, with pictures of the same if such could be obtained; a detailed discussion of the factors which we have found to contribute toward both success and failure; and a set of recipes. These recipes are given in detailed form and are really a résumé of the discussion.

It is not expected that anyone should have these long recipes before her when actually cooking. In fact, if such a procedure is attempted, we can predict failure from the start, since the delay caused by trying to figure out what to do next and how to do it will in itself be sufficient to ruin the product. The plan we suggest, taking muffins as an illustration, is this: Read carefully the specific discussion on muffins—how a good muffin should look, what ingredients to use, what manipulation to follow, and how to bake. After this, read over the recipe for the particular kind of muffin to be made and, when a choice is given between different ingredients, decide which ones are to be used. Then write an abbreviated recipe, setting down only those things which are hard to remember, such as proportion of ingredients and the suggested length of the stirring and baking periods. The abbreviated recipe for muffins given on page 72 is not meant as a

model but simply as a suggestion for the sort of thing each person should write for herself.

It will be observed that, for the most part, each of the following recipes is complete in itself, with no mention made of its similarity to another from which it may have been derived. Thus the recipes for the different kinds of muffins are given in detail, although all are quite similar to that for plain muffins and could be written as modifications of it. This was not done because of the confusion and consequent annoyance which result from trying to assemble the parts of a scattered recipe. The same is true of the cake recipes: most of these are closely related, but, for simplicity, each is written as a unit complete in itself.

In order to assist the beginner in estimating the time she should take to prepare articles of the batter-and-dough series we have kept a record of the preparation time of a number of people at their first, second, and sometimes even their third and fourth trials. Invariably we have found that on repetition each operation was markedly speeded up, provided the worker did some planning between successive trials. Thus one young woman took 60 minutes to make her first apple pie, 32 minutes for her second, and 25 for her third.

The time given at the head of each set of directions is that which was attained after a few trials.

CHAPTER III

MUFFINS

CHARACTERISTICS OF GOOD MUFFINS

TO BE good, muffins should be very light—so light, in fact, that when one picks them up one is surprised that anything of their size should weigh so little. The outside should be baked to a golden-brown shade; should be symmetrical in shape, with no tendency to form peaks or knobs at the top; and should have a somewhat pebbled, rather than a smooth and even, surface. The inside should show round holes of fairly uniform size but should have none of the long, narrow ones sometimes called "tunnels."

INGREDIENTS

Flour.—So far as our experience goes, it makes no difference which type of flour is used in muffins, provided the thickness of the batter is kept about the same. This means that the quantity of flour used should vary with the type. Thus in place of 1 cup of hard-wheat family flour, about $1\frac{3}{8}$ cups of soft-wheat flour should be used. Since cake and self-rising flours are made from soft wheat, this generalization applies to them.

If, however, self-rising flours are used, the baking powder and salt should, of course, be omitted, and the muffins should be baked at the temperature given for batters made with anhydrous calcium phosphate baking powder.

Liquid.—Muffins are just as good made with buttermilk, sour milk, or sour cream as with sweet, provided the souring has taken place rapidly enough that an unpleasant taste has not developed and provided that soda, when used, is added in just barely large enough quantities to neutralize the acid of the milk

or cream. When using soda, we have our best results with only $\frac{1}{2}$ teaspoon of soda per cup of sour milk and about half to three-fourths as much baking powder as with sweet milk or cream. When a baking powder containing calcium carbonate is used, the soda may be omitted, if the full amount of baking powder is added.

Fat.—All cooking oils and fats of low melting-point, such as butter, lard, bacon fat, chicken fat, and the various hydrogenated vegetable oils, can be used successfully in muffins made according to our directions. The solid fats should be heated just long enough to melt them, then measured and turned into the milk-egg mixture, and this mixture combined with the dry ingredients before the fat cools sufficiently to solidify.

MANIPULATION OF INGREDIENTS

The important thing in making muffins is barely to dampen the dry ingredients. The difference between success and failure is a matter of only a few strokes of the stirring spoon. The very small amount of mixing involved in dampening the dry ingredients apparently is enough to develop a gluten structure, which (with the egg) is sufficiently strong to support the expanding gas cells and yet not too strong to stretch easily. The resulting muffin, therefore, is light and has a symmetrical contour. A little overmixing, on the other hand, appears to develop such a strong gluten structure that it resists rising and tends to make the muffins small. Furthermore, it permits enough pressure to build up inside to push unbaked dough from the interior through the weakest spot in the partially baked crust. As a consequence, the muffins are knobby or peaked on top.

Aside from an overdeveloped gluten, another probable cause of small volume is a loss of carbon dioxide during mixing. That such may be the case is indicated by several studies,[1] in which

[1] R. A. Barackman, "Chemical Leavening Agents and Their Characteristic Action in Doughs," *Cereal Chemistry*, VIII (1931), 423–33; I. T. Noble and E. G. Halliday, "A Quantitative Measurement of the Carbon Dioxide Evolved in and Lost from Simplified Muffin Batters," *Cereal Chemistry*, VIII (1931), 165–67; E. Miller and B. Allen, "Problems in Cake Making," *Journal of Home Economics*, X (1918), 542–47.

it was found that batters low or lacking in sugar, as are these muffins, tend to lose gas readily. Whatever the cause or combination of causes, certain it is that overstirred muffins are small in volume, soggy, peaked, and tunneled, like those of Figures 32 and 34. The only difference between this and the one pictured in Figures 31 and 33 is that the poor one was stirred a few seconds longer.

Unfortunately, we can give no one stirring-time which can be counted on to produce equally good results under all conditions, for the optimum time varies with the individual's rate and vigor of movement. A general rule, however, which works fairly well for everybody is to move the mixing spoon quickly around the bowl in such a way that each stroke brings dry ingredients into contact with wet ones and to stop the instant the dry ingredients are dampened. This does not mean stir until all lumps are out and a smooth batter is obtained, but just what it says, *until all dry ingredients are dampened.* As we stir, this takes 17 seconds, beginning to count the time with the first stroke made after turning the mixed liquid ingredients all at once into the dry ones. This time does not hold for everybody. One student in our laboratory, for example, was able to reach the "just-dampened" stage in 10 seconds, while others have taken anywhere up to 28 seconds, all of us obtaining muffins of practically the same quality.

The beginner who really wants to learn to make good muffins should time her stirring operations during the learning period and try to correlate the time used with the appearance of the batter and of the finished muffins. If the latter are coarser than the one in Figure 33, she has not stirred long enough; if they show tunnels and peaks, as in Figure 34, she has overstirred them. Somewhere between the two extremes is the happy mean at which she will soon be able to arrive without timing herself, simply by knowing how the batter should look when she stops stirring.

Muffins should be placed in the pans as soon as one stops stirring them. In doing this, handle the batter with care, tak-

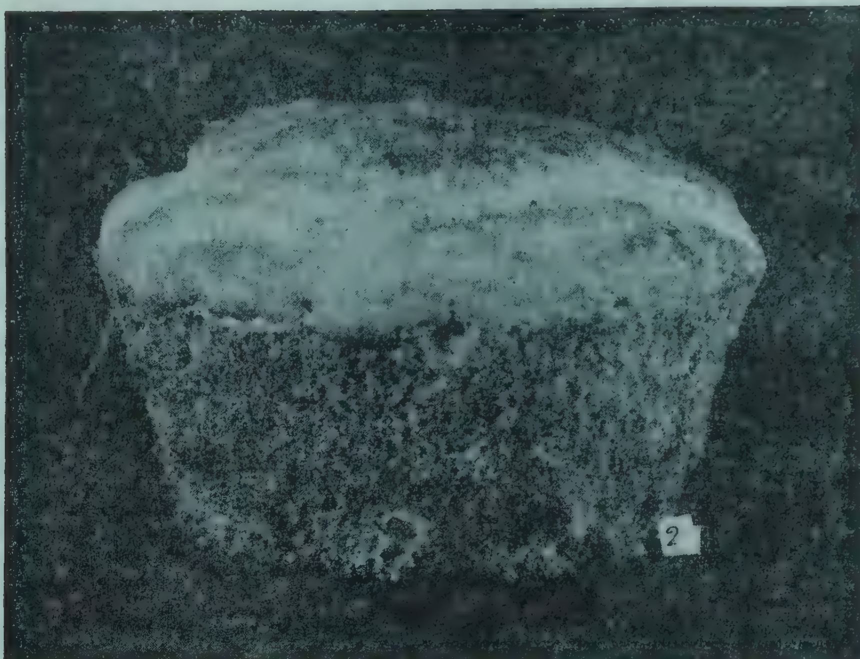


FIG. 31.—Exterior view of a muffin made by an inexperienced person who *had* been warned against overstirring. The symmetrical shape, the somewhat pebbled surface, and the height are all characteristic of a good muffin.

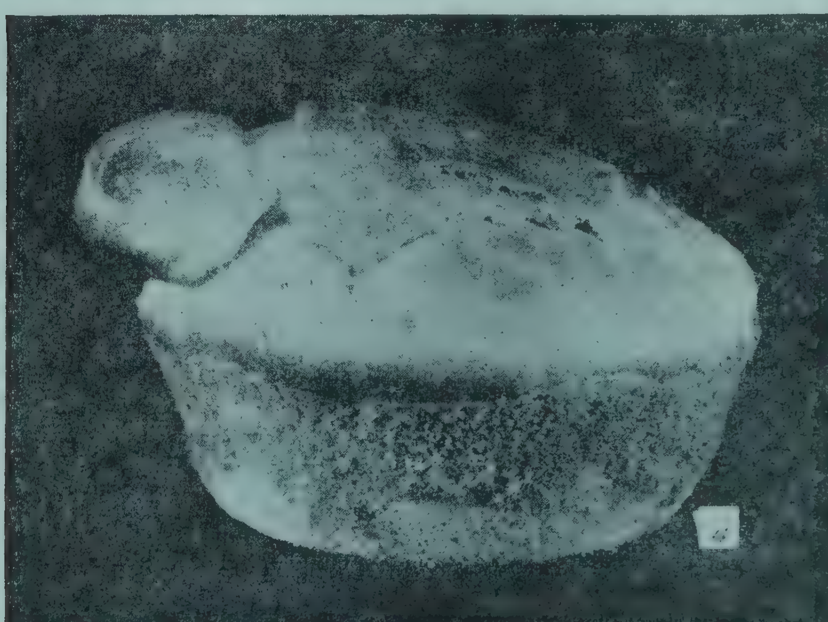


FIG. 32.—Exterior view of a muffin made by an inexperienced person who *had not* been warned against overstirring. The knoblike projection is an earmark of overstirred muffins.

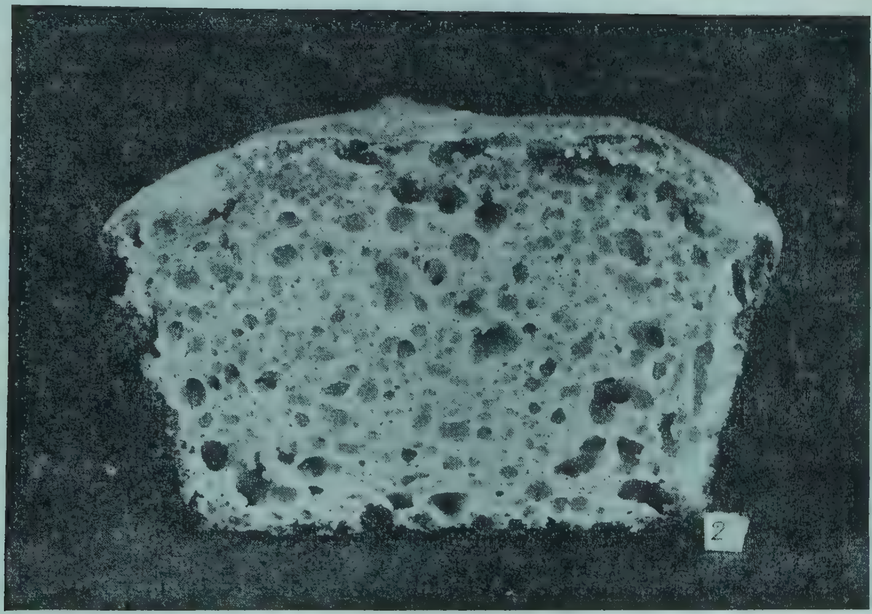


Fig. 33.—Interior view of the muffin shown in Figure 31. The slightly rounded top and the freedom from large holes and tunnels are characteristic of good plain muffins.

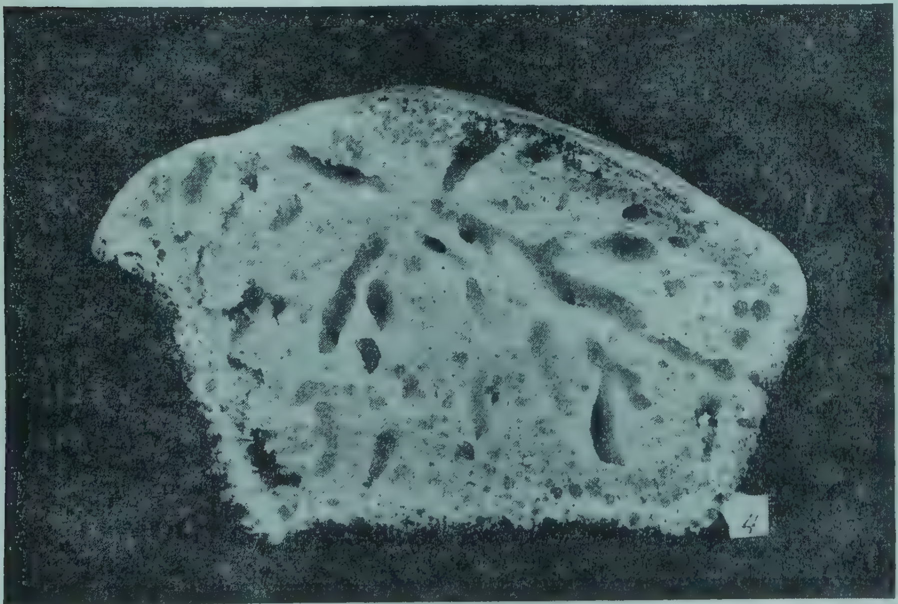


Fig. 34.—Interior view of the muffin shown in Figure 32. The long, tunnel-like holes are as characteristic of overbeaten muffins as are knoblike projections.

ing it up by spoonfuls and placing it lightly in the pans, filling each section about two-thirds full before passing on to the next. Rough handling will cause loss of carbon dioxide and therefore tend to make the muffins heavy.

Standing in covered pans from $\frac{1}{2}$ to $\frac{3}{4}$ of an hour before baking does no harm.

DIRECTIONS FOR THE PREPARATION OF MUFFINS

Before attempting to use these recipes, read the preceding discussion of muffins and the section on weighing and measuring (p. 35).

Yield

Each muffin recipe makes 10 muffins about $2\frac{1}{2}$ inches in diameter and $1\frac{1}{2}$ inches high.

Utensils

A 2-quart, heavy mixing bowl, similar in shape to the one shown in Figure 25 (p. 59).

Baking pans

Total capacity: 1,000 cubic centimeters (approximately $4\frac{1}{4}$ cups).

In this laboratory, 10 muffin-pan sections, each holding 100 cubic centimeters (approximately 7 tablespoons), are used.

Approximate preparation time after a few trials

Ten minutes, exclusive of the baking period of about 20 minutes.

PLAIN MUFFINS: SWEET MILK

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family......	226	2 cups
or		
Soft-wheat family *or* cake	264	$2\frac{3}{4}$ cups
Baking powder		
Tartrate...............	14.5	4 teaspoons
or		

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Hydrated phosphate.....	16.0	4 teaspoons
or		
Anhydrous phosphate....	10.8	3 teaspoons
or		
S.A.S.–phosphate........	11.0	3 teaspoons
Sugar....................	25	2 tablespoons
Salt.....................	....	½ teaspoon
Egg......................	48	1 medium sized
Milk.....................	259	252 cubic centimeters (1 cup plus 1 tablespoon)
Fat (melted or a liquid fat)	40	3 tablespoons

Order of work: Detailed form

1. Assemble the ingredients and the utensils needed in the preparation of the muffins. Oil the muffin tins.
2. Light the oven. Set it at 425° F. if a tartrate or hydrated-phosphate baking powder is to be used, or at 300° F. if an anhydrous phosphate or S.A.S.–phosphate powder is to be used.
3. (*a*) Weigh or measure the flour, baking powder, and sugar. Measure the salt. Mix these together; then sift them into the mixing bowl.
   b) Beat the egg until it is foamy.
   c) Weigh or measure the milk. Turn it into the egg.
   d) Weigh or measure the fat. (If one of the solid fats is used, melt it before weighing or measuring.) Turn it into the egg-milk mixture.
4. Combine the wet and dry ingredients as follows:

   Just as soon as the fat has been poured into the egg and milk mixture, turn the wet ingredients into the dry ones all at one time, and immediately combine the two by bringing the dry ingredients into contact with the wet ones with as

little stirring as possible of the portions already dampened. Stop stirring the instant the dry ingredients are *just dampened*. (This will probably take from 10 to 20 seconds.) The batter will look very lumpy.

Special care should be taken to avoid overstirring, for muffins are more easily ruined by this than by any other means. Just a few seconds' overbeating makes the muffin batter rise to peaks and be full of large holes.

As soon as the beating-period is over, dip the batter into the muffin tins with as little stirring as possible. Fill each section in turn about two-thirds full.

5. Bake the muffins as follows:

   If a tartrate or hydrated phosphate baking powder was used, bake at 425° F. until the crusts are golden brown (about 20 minutes). If an anhydrous phosphate or S.A.S.–phosphate powder was used, bake at 300° F. for about 10 minutes (or until the batter has risen to almost double its original height), then at 425° F. for about 20 minutes longer.

6. Remove the muffins from the tins immediately after taking them out of the oven and serve them *at once*.

Order of work: Abbreviated form

If the person who makes the muffins chooses to measure the ingredients and to use a hydrated phosphate baking powder and a solid fat, a résumé of the recipe is somewhat as follows:

1. Light the oven (425° F.).
2. Measure the ingredients:

Hard-wheat family flour	2 cups	Mix, then sift together
Baking powder	4 teaspoons	
Sugar	2 tablespoons	
Salt	½ teaspoon	
Egg	1 medium sized	Mix together
Milk	1 cup plus 1 tablespoon	
Melted fat	3 tablespoons	

3. As soon as the melted fat has been added to the egg and milk, pour these ingredients into the dry ones and stir until the dry ingredients have become just dampened (between 10 and 20 seconds).
4. Avoid stirring the batter when it is being lifted from the bowl to the tins.
5. Bake until the crusts are a golden brown (about 20 minutes).

PLAIN MUFFINS: SOUR MILK

If thick sour milk or buttermilk is used instead of sweet milk, follow the recipe for sweet-milk plain muffins, save for the following changes:

1. Use $1\frac{1}{2}$ teaspoons (instead of 3) of S.A.S.–phosphate or anhydrous phosphate baking powder; 2 teaspoons (instead of 4) of tartrate or hydrated phosphate baking powder.
2. Use $\frac{1}{2}$ teaspoon of soda and 1 tablespoon of water. Mix the two together and stir into them the other wet ingredients. The soda may be omitted when a baking powder which contains calcium carbonate is used if the full amount of baking powder is added.

PLAIN MUFFINS: SWEET CREAM

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family......	188	$1\frac{2}{3}$ cups
or		
Soft-wheat family *or* cake	224	$2\frac{1}{3}$ cups
Baking powder		
Tartrate...............	14.5	4 teaspoons
or		
Hydrated phosphate.....	16.0	4 teaspoons
or		

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Anhydrous phosphate	10.8	3 teaspoons
or		
S.A.S.–phosphate	11.0	3 teaspoons
Sugar	25	2 tablespoons
Salt	....	½ teaspoon
Egg	48	1 medium sized
Cream (18 per cent)	239	1 cup

Order of work: Detailed form

1. Assemble all ingredients and utensils needed in the preparation of the muffins. Oil the muffin tins.
2. Light the oven. Set it at 425° F. if a tartrate or hydrated phosphate baking powder is to be used, or at 300° F. if an anhydrous phosphate or S.A.S.–phosphate powder is to be used.
3. (*a*) Weigh or measure the flour, baking powder, and sugar. Measure the salt. Mix these together; then sift them into the mixing bowl.
   b) Beat the egg until it is foamy.
   c) Weigh or measure the cream. Turn it into the egg.
4. Combine the wet and dry ingredients as follows:

   Turn the wet ingredients into the dry ones all at one time, and immediately combine the two by bringing the dry ingredients into contact with the wet ones with as little stirring as possible of the portions already dampened. Stop stirring the instant the dry ingredients are *just dampened.* (This will probably take from 10 to 20 seconds.) The batter will look very lumpy when the stirring-period is over.

   Special care should be taken to avoid overstirring, for muffins are more easily ruined by this than by any other means. Just a few seconds' overbeating makes the muffins rise to peaks and be full of large holes.

   As soon as the beating-period is over, dip the batter

into the muffin tins with as little stirring as possible. Fill each section in turn about two-thirds full.

5. Bake the muffins as follows:

   If a tartrate or hydrated phosphate baking powder was used, bake at 425° F. until the crusts are a golden brown (about 20 minutes). If an anhydrous phosphate or S.A.S.–phosphate powder was used, bake at 300° F. for about 10 minutes (until the batter has risen to almost double its original height), then at 425° F. for about 20 minutes longer.

6. Remove the muffins from the tins immediately after taking them from the oven, and serve them *at once.*

PLAIN MUFFINS: SOUR CREAM

If freshly soured cream is used instead of sweet cream, follow the recipe for sweet-cream muffins except for the following changes:

1. Use 2 teaspoons (instead of 4) of tartrate or hydrated phosphate baking powder; 1½ teaspoons (instead of 3) of anhydrous phosphate or S.A.S.–phosphate baking powder.
2. Use ½ teaspoon of soda and 1 tablespoon of water. Mix the two together and stir into them the other wet ingredients. The soda may be omitted when a baking powder which contains calcium carbonate is used if the full amount of baking powder is added.

GRAHAM MUFFINS: SWEET MILK

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	141	1¼ cups
or		
Soft-wheat family *or* cake	168	1¾ cups
Baking powder		
Tartrate.	14.5	4 teaspoons
or		

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Hydrated phosphate	16.0	4 teaspoons
or		
Anhydrous phosphate	10.8	3 teaspoons
or		
S.A.S.–phosphate	11.0	3 teaspoons
Sugar	25	2 tablespoons
Salt	....	$\frac{1}{2}$ teaspoon
Graham flour	145	$1\frac{1}{4}$ cups
Egg	48	1 medium sized
Milk	244	237 cubic centimeters (1 cup)
Fat (melted or a liquid fat)	40	3 tablespoons

Order of work: Detailed form

1. Assemble all ingredients and utensils needed in the preparation of the muffins. Oil the muffin pans.
2. Light the oven. Set it at 425° F. if a tartrate or hydrated phosphate baking powder is to be used, or at 300° F. if an anhydrous phosphate or S.A.S.–phosphate powder is to be used.
3. (*a*) Weigh or measure the white flour, baking powder, and sugar. Measure the salt. Mix these together; then sift them into the mixing bowl.
   b) Weigh or measure the graham flour. Stir it into the mixture of flour, baking powder, sugar, and salt.
   c) Beat the egg until it is foamy.
   d) Weigh or measure the milk. Turn it into the egg.
   e) Weigh or measure the fat. (If one of the solid fats is used, melt it before weighing or measuring.) Turn it into the egg-milk mixture.
4. Combine the wet and dry ingredients as follows:
   Just as soon as the fat has been poured into the egg and milk mixture, turn the wet ingredients into the dry ones all

at one time, and immediately combine the two by bringing the dry ingredients into contact with the wet ones with as little stirring as possible of the portions already dampened. Stop stirring the instant the dry ingredients are *just dampened*. (This probably will take from 10 to 20 seconds.)

Special care should be taken to avoid overstirring, for muffins are more easily ruined by this than by any other means. Just a few seconds' overbeating makes the muffin batter rise to peaks and be full of large holes.

As soon as the beating-period is over, dip the batter into the muffin tins with as little stirring as possible. Fill each section in turn about two-thirds full.

5. Bake the muffins as follows:

   If a tartrate or hydrated phosphate baking powder was used, bake at 425° F. until the crusts are golden brown (about 25 minutes). If an anhydrous phosphate or S.A.S.–phosphate powder was used, bake at 300° F. for about 10 minutes (or until the batter has risen to almost double its original height), then at 425° F. for about 20 minutes longer.

6. Remove the muffins from the tins immediately after taking them out of the oven, and serve them *at once*.

GRAHAM MUFFINS: SOUR MILK

If sour milk, freshly clabbered, or buttermilk is used instead of sweet milk, follow the recipe for sweet-milk graham muffins except for the following changes:

1. Use 3 teaspoons (instead of 4) of tartrate or hydrated phosphate baking powder; 2 teaspoons (instead of 3) of anhydrous phosphate or S.A.S.–phosphate baking powder.
2. Use ½ teaspoon of soda and 1 tablespoon of water. Mix the two together and stir into them the other wet ingredients. The soda may be omitted when a baking powder which contains calcium carbonate is used if the full amount of baking powder is added.

GRAHAM MUFFINS: SWEET CREAM

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	113	1 cup
or		
Soft-wheat family *or* cake	144	$1\frac{1}{2}$ cups
Baking powder		
Tartrate	14.5	4 teaspoons
or		
Hydrated phosphate	16.0	4 teaspoons
or		
Anhydrous phosphate	10.8	3 teaspoons
or		
S.A.S.–phosphate	11.0	3 teaspoons
Sugar	25	2 tablespoons
Salt	....	$\frac{1}{2}$ teaspoon
Graham flour	145	$1\frac{1}{4}$ cups
Egg	48	1 medium sized
Cream (18 per cent)	239	1 cup

Order of work: Detailed form

1. Assemble all ingredients and utensils needed in the preparation of the muffins. Oil the muffin tins.
2. Light the oven. Set it at 425° F. if a tartrate or hydrated phosphate baking powder is to be used, or at 300° F. if an anhydrous phosphate or S.A.S.–phosphate powder is to be used.
3. (*a*) Weigh or measure the white flour, baking powder, and sugar. Measure the salt. Mix these together; then sift them into the mixing bowl.
   b) Weigh or measure the graham flour. Stir it into the mixture of flour, baking powder, sugar, and salt.
   c) Beat the egg until it is foamy.
   d) Weigh or measure the cream. Turn it into the egg.

4. Combine the wet and dry ingredients as follows:

   Turn the wet ingredients into the dry ones all at one time, and immediately combine the two by bringing the dry ingredients into contact with the wet ones with as little stirring as possible of the portions already dampened. Stop stirring the instant the dry ingredients are *just dampened*. (This probably will take from 10 to 20 seconds.)

   Special care should be taken to avoid overstirring, for muffins are more easily ruined by this than by any other means. Just a few seconds' overbeating makes the muffin batter rise to peaks and be full of large holes.

   As soon as the beating-period is over, dip the batter into the muffin tins with as little stirring as possible. Fill each section in turn about two-thirds full.

5. Bake the muffins as follows:

   If a tartrate or hydrated phosphate baking powder was used, bake at 425° F. until the crusts are golden brown (about 25 minutes). If an anhydrous phosphate or S.A.S.–phosphate powder was used, bake at 300° F. for about 10 minutes (or until the batter has risen to almost double its original height), then at 425° F. for about 20 minutes longer.

6. Remove the muffins from the tins immediately after taking them out of the oven, and serve them *at once.*

GRAHAM MUFFINS: SOUR CREAM

If freshly soured cream is used instead of sweet cream, follow the recipe for sweet-cream graham muffins except for the following changes:

1. Use 3 teaspoons (instead of 4) of tartrate or hydrated phosphate baking powder; use 2 teaspoons (instead of 3) of S.A.S.–phosphate or anhydrous phosphate baking powder.
2. Use $\frac{1}{2}$ teaspoon of soda and 1 tablespoon of water. Mix the two together and stir into them the other wet ingredients.

The soda may be omitted when a baking powder which contains calcium carbonate is used if the full amount of baking powder is added.

RAISIN, DATE, OR NUT MUFFINS

Add $\frac{1}{2}$ cup of finely chopped raisins, dates, or nuts to the sifted dry ingredients of any of the foregoing recipes and then proceed according to the directions for that recipe.

CORN-MEAL MUFFINS: SWEET MILK

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	170	$1\frac{1}{2}$ cups
or		
Soft-wheat family *or* cake	216	$2\frac{1}{4}$ cups
Baking powder		
Tartrate	14.5	4 teaspoons
or		
Hydrated phosphate	16.0	4 teaspoons
or		
Anhydrous phosphate	10.8	3 teaspoons
or		
S.A.S.–phosphate	11.0	3 teaspoons
Sugar	25	2 tablespoons
Salt	....	$\frac{1}{2}$ teaspoon
Corn meal (yellow or white)	108	$\frac{3}{4}$ cup
Egg	48	1 medium sized
Milk	244	237 cubic centimeters (1 cup)
Fat (melted or liquid fat)	40	3 tablespoons

Order of work: Detailed form

1. Assemble all ingredients and utensils needed in the preparation of the muffins. Oil the muffin tins.

2. Light the oven. Set it at 425° F. if a tartrate or hydrated phosphate baking powder is to be used, or at 300° F. if an anhydrous phosphate or S.A.S.–phosphate powder is to be used.
3. (*a*) Weigh or measure the flour, baking powder, and sugar. Measure the salt. Mix these together; then sift them into the mixing bowl.
   b) Weigh or measure the corn meal. Stir it into the mixture of flour, baking powder, sugar, and salt.
   c) Beat the egg until it is foamy.
   d) Weigh or measure the milk. Turn it into the egg.
   e) Weigh or measure the fat. (If one of the solid fats is to be used, melt it before weighing or measuring.) Turn it into the egg-milk mixture.
4. Combine the wet and dry ingredients as follows:

   Just as soon as the fat has been poured into the egg and milk mixture, turn these wet ingredients into the dry ones all at one time, and immediately combine the two by bringing the dry ingredients into contact with the wet ones with as little stirring as possible of the portions already dampened. Stop stirring the instant the dry ingredients are *just dampened.* (This will probably take from 10 to 20 seconds.)

   Special care should be taken to avoid overstirring, for muffins are more easily ruined by this than by any other means. Just a few seconds' overbeating makes the muffin batter rise to peaks and be full of large holes.

   As soon as the beating-period is over, dip the batter into the muffin tins with as little stirring as possible. Fill each section in turn about two-thirds full.
5. Bake the muffins as follows:

   If a tartrate or hydrated phosphate baking powder was used, bake at 425° F. until the crusts are golden brown (about 25 minutes). If a S.A.S.–phosphate or anhydrous phosphate powder was used, bake at 300° F. for about 10 minutes (or until the batter has risen to almost double its

original height), then at 425° F. for about 20 minutes longer.

6. Remove the muffins from the tins immediately after taking them out of the oven, and serve them *at once.*

CORN-MEAL MUFFINS: SOUR MILK

If sour milk, freshly clabbered, or buttermilk is used instead of sweet milk, follow the recipe for sweet-milk corn-meal muffins except for the following changes:

1. Use 3 teaspoons (instead of 4) of tartrate or hydrated phosphate baking powder; 2 teaspoons (instead of 3) of anhydrous phosphate or S.A.S.–phosphate baking powder.
2. Use ½ teaspoon of soda and 1 tablespoon of water. Mix the two together and stir into them the other wet ingredients. The soda may be omitted when a baking powder which contains calcium carbonate is used if the full amount of baking powder is added.

CORN-MEAL MUFFINS: SWEET CREAM

Proportion of Ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	141	1¼ cups
or		
Soft-wheat family *or* cake	192	2 cups
Baking powder		
Tartrate	14.5	4 teaspoons
or		
Hydrated phosphate	16.0	4 teaspoons
or		
Anhydrous phosphate	10.8	3 teaspoons
or		
S.A.S.–phosphate	11.0	3 teaspoons
Sugar	25	2 tablespoons
Salt	....	½ teaspoon

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Cornmeal (yellow or white)	108	$\frac{3}{4}$ cup
Egg	48	1 medium sized
Cream (18 per cent)	239	1 cup

Order of work: Detailed form

1. Assemble the ingredients and the utensils needed in the preparation of the muffins. Oil the tins.
2. Light the oven. Set it at 425° F. if a tartrate or hydrated phosphate baking powder is to be used, or at 300° F. if an anhydrous phosphate or S.A.S.–phosphate powder is to be used.
3. (*a*) Weigh or measure the flour, baking powder, and sugar. Measure the salt. Mix these together, then sift them into the mixing bowl.
   b) Weigh or measure the corn meal. Stir it into the mixture of flour, baking powder, sugar, and salt.
   c) Beat the egg until it is foamy.
   d) Weigh or measure the cream. Turn it into the egg.
4. Combine the wet and dry ingredients as follows:

   Turn the wet ingredients into the dry ones all at one time, and immediately combine the two by bringing the dry ingredients into contact with the wet ones with as little stirring as possible of the portions already dampened. Stop stirring the instant the dry ingredients are *just dampened.* (This probably will take from 10 to 20 seconds.)

   Special care should be taken to avoid overstirring, for muffins are more easily ruined by this than by any other means. Just a few seconds' overbeating makes the muffin batter rise to peaks and be full of large holes.

   As soon as the beating-period is over, dip the batter into the muffin tins with as little stirring as possible. Fill each section in turn about two-thirds full.

5. Bake the muffins as follows:

   If a tartrate or hydrated phosphate baking powder was used, bake at 425° F. until the crusts are golden brown (about 25 minutes). If an anhydrous phosphate or S.A.S.–phosphate powder was used, bake at 300° F. for about 10 minutes (or until the batter has risen to almost double its original height), then at 425° F. for about 20 minutes longer.
6. Remove the muffins from the tins immediately after taking them out of the oven, and serve them *at once.*

CORN-MEAL MUFFINS: SOUR CREAM

If freshly soured cream is used instead of sweet cream, follow the recipe for sweet-cream corn-meal muffins except for the following changes:

1. Use 3 teaspoons (instead of 4) of tartrate or hydrated phosphate baking powder; 2 teaspoons (instead of 3) of anhydrous phosphate or S.A.S.–phosphate baking powder.
2. Use $\frac{1}{2}$ teaspoon of soda and 1 tablespoon of water. Mix the two together and stir into them the other wet ingredients. The soda may be omitted when a baking powder which contains calcium carbonate is used if the full amount of baking powder is added.

CHAPTER IV

CAKES CONTAINING SHORTENING

THE really excellent "butter" cake has certain characteristics which are hard to describe and impossible to photograph. These, for want of better words, we call "velvetiness" and "featheriness," meaning by the first that the inside of the cake has the feeling of soft velvet to the tongue or fingers and by the second that it has a structure so delicate that it almost melts in the mouth. Cakes which have these characteristics are always very light and of a fairly even grain, which is to say that for the most part they have small holes evenly distributed. But these qualities of lightness and evenness do not insure the velvety or feathery feeling—they may be present and either or both of the others lacking. In addition, it may be added, this ideal cake has a delicate flavor not masked by oversweetness.

How to produce such a cake is something on which authorities are not agreed at present. There is, in fact, considerable variation in the manipulation and in the proportion and kind of ingredients recommended. At the risk of being considered a bit behind the times, we will say at once that in our opinion the good old-fashioned conventional method is still unequaled, because of the texture it gives and because butter and a relatively low proportion of sugar can be used with it.

As is well known, however, the conventional method requires a high degree of skill. Moreover, it is laborious and time-consuming, so that not everyone has the time, the patience, or, indeed, the inclination to develop the very special technique required for a first-class product by this method. For this reason we are giving two other much shorter methods, in one of which the in-

gredients are the same as those used in the conventional method, in the other the proportions of sugar and liquid are much higher. The first of these is essentially the method used for muffins and is so designated. The second is an adaptation of one long used by bakers, hence we are calling it "modified bakers' method."

Plain cakes such as those given in this chapter tend to lose some of their quality on standing for twenty-four hours or longer and become slightly stale. This tendency is more pronounced in cakes made by the muffin than by the conventional method. The reason for this appears to be that the quality of staleness is not altogether a matter of dryness (in other words, actual loss of water) but is partly a question of the distribution of the water[1] among the different components of the mixture. When cakes or other baked products cool, the water tends to distribute itself in such a way as to make for staleness—a tendency which appears to be checked if the ingredients are really thoroughly mixed, which is the condition existing in our velvety cake. Fortunately, the change can be partially reversed by reheating.

MANIPULATION OF INGREDIENTS

CONVENTIONAL METHOD

Our order of work for the conventional method is the time-honored one, which is to cream the fat; add the sugar gradually; then the egg yolks; after that the flour, baking powder, and salt mixture alternately with the liquid, beginning and ending with the former; and, finally, to stir in the beaten whites. Following this order of work, however, does not necessarily make a good cake, as can be seen by examining those pictured in Figures 35 and 36.[2] Both of these were put together in the conventional order, and both were made by the same person from the same lot of ingredients. The only difference between the two was in the thoroughness of combining the ingredients. For the cake of

[1] J. R. Katz, "Das Altbackenwerden der Brotkrume vom physiologischchemischen Standpunkte betrachtet," *Zeitschrift für physiologische Chemie*, XCV (1915), 104.

[2] Cakes made by Gladys Vail.

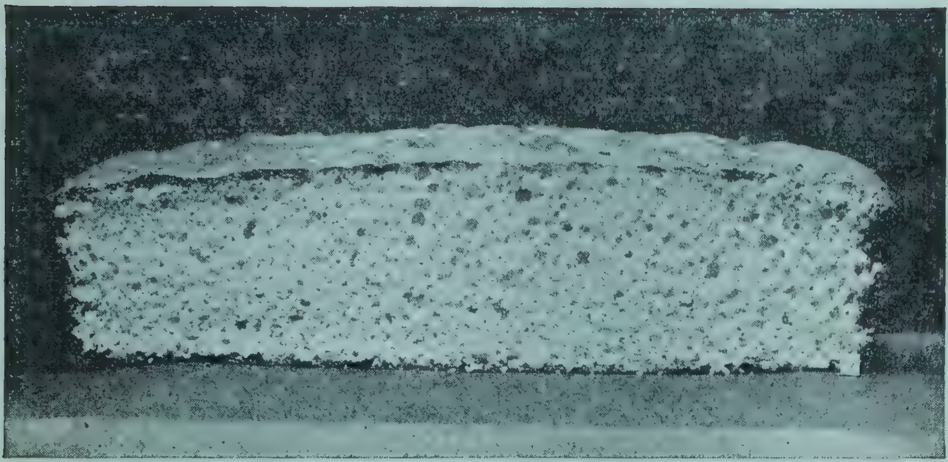


FIG. 35.—Butter cake in which the ingredients were thoroughly combined. The uniform thickness of the cake, its lightness, and even grain are noticeable.

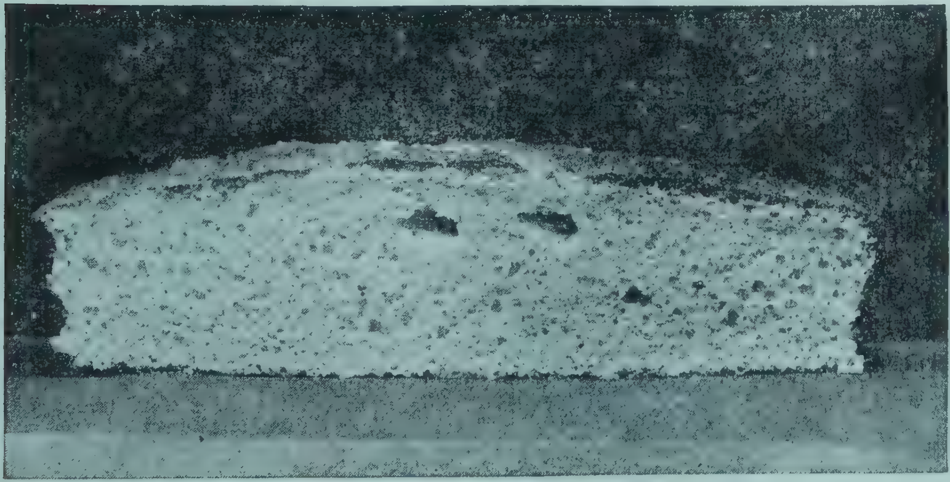


FIG. 36.—Butter cake in which the ingredients were not thoroughly combined. The rounded top, the soggy layer along the bottom and just beneath the crust, as well as the uneven grain, were much more prominent in the cake than the picture shows.

Figure 36, the process was skimped a little at every point, as a consequence of which a smooth mixture was not obtained and the resulting cake had a very poor texture and was of a smaller volume than the cake of Figure 35. The difference between the cakes was much more pronounced than the pictures show, the one being excellent, the other a failure.

At our speed of work it takes about 13 minutes to combine the ingredients—13 minutes of actual work, for when we stop to rest we take "time out." This means a good deal of beating, a large proportion of which must be done before the addition of milk, that is, in combining the fat, sugar, egg yolk, and first portion of flour.

We have not found that it made any decided difference to the final result where we put the emphasis in this preliminary beating, provided we do some of it after adding the first portion of flour. In other words, if we skimp the beating at one part, say in creaming the fat, we can make up for it in another. It is much easier, however, to follow the usual procedure and beat thoroughly at each stage in the process rather than to postpone the beating until more of the ingredients are added and the mixture is harder to handle.

For our proportions and this particular method of work we have not found it possible to obtain a good texture from either melted fats or fats too hard and solid to be plastic. Accordingly, on a hot summer day we set the bowl during mixing in a pan of cool (about 65° F.) water or put the whole mixture back into the refrigerator after the preliminary process, which is to say, up to and including the addition of the first portion of the flour; and on a winter day we let the fat stand out of the refrigerator for some time before we start working with it. In this way the batter is kept around 73° F., which is the temperature found most favorable by a committee of the American Association of Cereal Chemists.[3]

[3] V. E. Fisher, "Report of Committee on Testing Cake and Biscuit Flours: Effect of Temperature on the Dough and Its Influence on the Standard Baking Test," *Cereal Chemistry*, VII (1930), 367.

Before the first portion of milk is added, little delays do not matter; but, from then on, the process should be continuous. This is because the baking powder will start to react as soon as we begin to add the milk; hence, if we are exceedingly slow in our work, we may lose so much carbon dioxide that the cake will be heavy. And so, after adding the first portion of milk, we find it necessary to work continuously and quickly.

Furthermore, we find it advisable to add the flour and milk in small portions—alternating the two in such a way that flour comes last—and to beat the mixture vigorously after the addition of each portion of flour. This beating is important, for it enables the flour to become thoroughly combined with the other ingredients, thus lessening the tendency of the mixture to separate and favoring the production of a velvety cake. The optimum beating-time varies with the type of baking powder used; that which we have found most advantageous is given in each recipe.

Finally, we stir in the beaten whites as quickly as we can. Speed here appears to be more important than gentleness of movement, which counts for so much in angel food and sponge cakes (p. 127). In the latter the batters are sufficiently viscous, owing to the large proportion of egg, to hold in the air—which makes the cakes light—if we handle them with care. When fewer whites are used, as in the type of cake we are now considering, the mixture is less viscous and tends to lose considerable gas on stirring, no matter how gently we handle it. Since gas is continually forming from the baking powder, this loss in stirring is compensated for if we do not prolong the process until the gas-producing power of the baking powder is reduced too low to furnish enough for lightness. This an experienced worker is not at all likely to do; but an inexperienced one may, particularly a hardworking, conscientious person. On the other hand, the egg white must be thoroughly combined; otherwise the cake will be coarse. We have our best results when we stir at such a rate as to get a good smooth batter, with no flakes of egg white showing, in about 25 seconds.

The instant we finish stirring we turn the cake into the pan, and we bake it immediately or some time later, as happens to be convenient. We find that it makes no difference which we do—that cakes which have stood for a short time before baking are quite as good as those baked as soon as they are put into the pan. For purposes of experiment we have even allowed them to stand, covered with a cake pan, for as long as 3 hours in the refrigerator without being able to detect any change in their quality.

MUFFIN METHOD[4]

A good cake, light and of even grain, can be made, by the muffin method, from certain recipes with very little work. With it, butter and the same proportion of sugar as in the conventional method can be used, hence a very desirable flavor is obtained. Moreover, the process by which the ingredients are combined is so simple that a beginner can usually make about as good a product at the first trial as on later ones. The recipes given here which lend themselves to this easy manipulation are Plain Cakes I and II and the Spice Cake (pp. 92, 98, and 103). The method is the same as for muffins, save that the batter is beaten longer at the end of the combining period; and when a tartrate baking powder is used, the egg whites are beaten separately and added at the last, as in the conventional method.

We bake these cakes in muffin tins and serve them while warm. If any are left over, we re-warm before serving again. To do this we sprinkle them with cold water, replace them in the muffin tins, and heat in a hot oven—about 400° F.—until the water sprinked over them has evaporated and they are warmed through.

One precaution should be taken in using the muffin method for cakes, and that is to avoid having the melted fat extremely hot—or, worse yet, almost cold. Fats can reach a very high temperature, some of them well over 400° F., before they begin to smoke and thus give visible evidence of their decomposition. This accounts for the fact that they are frequently allowed to

[4] This method is not successful in very hot, damp weather.

become very hot when put over the fire to melt. An extremely hot fat warms up the whole mixture and consequently hastens the reaction of the baking powder, perhaps with disastrous results. On the other hand, a cool fat may solidify almost as soon as it strikes the cold milk, in which case it does not mix well with the other ingredients by this method of work, and therefore the cake will be coarse and granular.

MODIFIED BAKERS' METHOD

This method, as has been stated, calls for more sugar than the conventional method, hence the cakes made by it are somewhat sweeter. Furthermore, not all fats can be used in it with equal success. The ones specially recommended are those containing a small amount of emulsifying agent, probably in the form of a mono- or diglyceride. The two fats we have used with success are Crisco and Spry.

UTENSILS

a) *Mixing bowl.*—The amounts of batter for the different cakes made with fat are so nearly alike that all may be made in the same-sized bowl, preferably one having a capacity of 2 quarts and shaped like that shown in Figure 25, page 59.

b) *Baking pans.*—In baking these cakes, pans of different sizes are required, each of such a volume that the cake will completely fill it when fully risen but will have no tendency to bulge over the rim.

At the head of each recipe we have given the total capacity of the baking pans needed and also the actual dimensions of the ones we use in this laboratory and therefore the ones for which our baking periods were worked out. These periods will, of course, have to be increased somewhat for deeper pans and decreased for shallower ones. We prefer baking pans no more than $1\frac{1}{2}$ inches deep.

BAKING

a) *Temperature.*—Two baking temperatures are given for each cake, a lower one to allow the cake to rise to double its original height, a higher one to complete the baking.

b) *Tests.*—To make sure that a cake is sufficiently baked, we advise the beginner to use the well-known toothpick test. This is simply to run a toothpick into the center of the cake, pull it out, and note whether it comes out clean without any particles of dough sticking to it. A clean toothpick means a completely baked cake. The experienced cakemaker judges that a cake is done when the surface is not dented by touching it lightly with the finger.

No test should, of course, be made until the cake has baked for approximately the length of time specified in the directions for baking.

APPROXIMATE PREPARATION TIME AFTER A FEW TRIALS

a) *Conventional method.*—About 20 minutes, exclusive of the baking period.

b) *Muffin or modified bakers' method.*—About 10 minutes, exclusive of the baking period.

DIRECTIONS FOR THE PREPARATION OF CAKES

Before attempting to use these recipes, read the preceding discussion of cakes and the section on weighing and measuring (p. 35).

PLAIN CAKE I

Yield

As a two-layer cake: 10 "pie-shaped" pieces, $2\frac{1}{4}$ inches across the outer edge; as a loaf cake: 16 pieces, 2 inches by 2 inches by $1\frac{1}{2}$ inches; as cupcakes: 16 cupcakes, $2\frac{1}{2}$ inches in diameter and $1\frac{1}{4}$ inches high.

Baking pans

Capacity: 1,600 to 1,700 cubic centimeters (about 7 cups). Pans used in this laboratory:

a) Two layer-cake pans, $8\frac{1}{2}$ inches in diameter by 1 inch high.
b) One loaf-cake pan, $8\frac{1}{4}$ inches by $8\frac{1}{4}$ inches by $1\frac{1}{2}$ inches.
c) Sixteen muffin-pan sections, each of 100-cubic-centimeter capacity.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Butter	70	$\frac{1}{3}$ cup (about $\frac{2}{3}$ of a $\frac{1}{4}$-pound section)
or		
Butter	35	$2\frac{2}{3}$ tablespoons
and		
Hydrogenated fat	34	$2\frac{2}{3}$ tablespoons
Sugar	200	1 cup
Eggs		
Yolks	36	2 medium sized
Whites	60	2 medium sized
Cake flour	174	$1\frac{3}{4}$ cups plus 1 tablespoon
Baking powder		
S.A.S.–phosphate	7.5	2 teaspoons
or		
Anhydrous phosphate	7.3	2 teaspoons
or		
Hydrated phosphate	10.0	$2\frac{1}{2}$ teaspoons
or		
Tartrate	9.0	$2\frac{1}{2}$ teaspoons
Salt	....	$\frac{1}{4}$ teaspoon
Milk	163	158 cubic centimeters ($\frac{2}{3}$ cup)
Vanilla	....	$\frac{1}{2}$ teaspoon

Conventional method: Order of work: Detailed form

1. Assemble all ingredients and utensils needed in the preparation of the cake.

   Fit a piece of light-weight oiled or other thin paper into the bottom of the pan; oil the paper and the sides of the pan.

2. (*a*) Weigh or measure the fat. Place it in the mixing bowl. If the room is hot (80° F. or above), set the fat in a refrigerator until the rest of the ingredients are ready.

   b) Weigh or measure the sugar.

- *c*) Weigh or measure the flour and baking powder. Measure the salt. Mix the three well; then sift them together.
- *d*) Weigh or measure the milk.
- *e*) Measure the vanilla. Turn it into the milk.

3. Light the oven. Set it at 300° F. for a S.A.S.–phosphate or anhydrous phosphate baking powder; at 350° F. for a hydrated phosphate or tartrate baking powder.
4. Combine the fat, sugar, and egg yolks as follows:
   - *a*) Cream the fat with a wooden spoon until it is very plastic and a light-yellow color.
   - *b*) Add a little (about 1 tablespoon) of the sugar to the fat and beat until the mixture looks fluffy (this will take about 1 minute). Repeat until all the sugar is mixed with the fat. When this has been done, the resulting product should be a light-yellow, fluffy mixture of thoroughly blended fat and sugar, having the general appearance of hard sauce. Remove all material clinging to the spoon. If the room is hot, set the creamed fat and sugar in a refrigerator while the eggs are being separated and the whites beaten.
   - *c*) Separate the egg whites from the yolks; place the yolks in the fat-sugar mixture and the whites in a bowl in which they can be beaten conveniently. Beat the whites until they are stiff but not until they lose their shiny appearance.
   - *d*) Beat the egg yolks with the fat and sugar until they are thoroughly combined (30 seconds or more).
5. Combine the remaining ingredients as follows:
   - *a*) Add one heaping tablespoon of the mixture of flour, baking powder, and salt to the fat-sugar-egg mixture. Stir until the flour is dampened (about 10 seconds), then beat for 30 seconds.

     The mixing process should be continuous from now until the batter is in the pan. Therefore, be sure that everything needed is at hand.

b) Add about one-fifth, approximately 2 tablespoons, of the milk. With a few gentle strokes mix it slightly (not thoroughly) with the other ingredients.

c) Repeat this addition of flour and milk alternately, using the same amounts and the same method of combination as given above, except shorten the beating-period after the dampening of the flour to 10 seconds. End with a portion of flour.

d) When all the flour has been added and the last portion dampened, beat the batter for 1 minute if a S.A.S.–phosphate or anhydrous phosphate, for 30 seconds if a hydrated phosphate, or for 15 seconds if a tartrate, baking powder has been used.

e) Add the beaten whites and stir gently but quickly until the mixture can be beaten without spattering—about 5 seconds. Then beat for 25 seconds. Immediately turn the batter into the oiled tins.

The total time elapsing between the beginning of step *b* and the end of step *e* should not be longer than about 6 minutes.

6. Bake[5] the cake as follows:
   a) For a S.A.S.–phosphate or an anhydrous phosphate baking powder:
      (1) Layer cake—at 300° F. during the first 10 minutes, then at 375° F. for about 25 minutes longer.
      (2) Loaf cake—at 300° F. during the first 20 minutes, then at 375° F. for about 25 minutes longer.
      (3) Cupcakes—at 300° F. during the first 10 minutes, then at 375° F. for about 15 minutes longer.
   b) For a hydrated phosphate or tartrate baking powder:
      (1) Layer cake—at 350° F. during the first 10 minutes, then at 375° F. for about 20 minutes longer.
      (2) Loaf cake—at 350° F. during the first 20 minutes, then at 375° F. for about 20 minutes longer.

[5] Baking tests are given on p. 92.

(3) Cupcakes—at 350° F. during the first 10 minutes, then at 375° F. for about 15 minutes longer.

7. As soon as the cake is taken from the oven, remove it from the tin and take the paper off the bottom. Place the cake on a rack to cool.

Conventional method: Order of work: Abbreviated form

If the person who is to make the cake chooses to use butter for the fat, to use a S.A.S.–phosphate baking powder, to weigh the troublesome ingredients, to bake as a layer cake and if the room is cool, a résumé of the recipe is somewhat as follows:

1. Weigh or measure the ingredients:

Butter	70 grams
Sugar	200 grams
Flour	174 grams
Baking powder	2 teaspoons
Salt	$\frac{1}{4}$ teaspoon
Milk	158 cubic centimeters ($\frac{2}{3}$ cup)
Vanilla	$\frac{1}{2}$ teaspoon

2. Light oven (300° F.).
3. Cream fat and sugar (5 minutes or more).
4. Separate egg whites and yolks; use 2 whites (60 grams) and 2 yolks (36 grams); beat whites.
5. Beat yolks with fat and sugar (30 seconds or more).
6. Add flour and milk alternately, beginning and ending with flour.

   Flour should be beaten in; milk only partially mixed.
7. After adding the last portion of flour, beat 1 minute.
8. Stir in beaten egg whites, then beat 25 seconds.
9. Bake 10 minutes at 300° F., then 25 minutes at 375° F.

Muffin method: Order of work

1. Assemble all ingredients and utensils needed in the preparation of the cake. Oil the baking pans—muffin tins are to be preferred. Cakes are readily removed if the pans are lined with paper cups.

2. Weigh or measure the ingredients:

Flour Baking powder Sugar Salt	Mix, then sift together into the mixing bowl

Egg: For a S.A.S.–phosphate, anhydrous phosphate, or hydrated phosphate baking powder, beat the yolks and whites together until foamy; for a tartrate baking powder, beat the yolks and whites separately, the whites until they are stiff.

Milk Vanilla	Turn into the whole egg, or into the egg yolks if the whites and yolks were beaten separately.

Butter: Melt before weighing or measuring. After weighing or measuring, turn into the egg-milk-vanilla mixture.

3. Combine the wet and dry ingredients as follows:
   a) Make a well in the center of the dry ingredients.
   b) If a S.A.S.–phosphate, anhydrous phosphate, or hydrated phosphate baking powder was used, turn all the wet ingredients into the well and stir as vigorously as possible until the batter can be beaten without spattering (about 20 seconds). Then beat for 1 minute.

   If a tartrate baking powder was used, turn all the wet ingredients into the well and stir as vigorously as possible until the batter can be beaten without spattering. Beat for 15 seconds; stir in the beaten egg whites and continue beating for 25 seconds.
4. Bake (in muffin pans) at 300° F. for the first 10 minutes, then at 375° F. for about 15 minutes longer if a S.A.S.–phosphate or anhydrous phosphate baking powder was used; at 350° F. for the first 10 minutes, then at 375° F. for about 15 minutes longer, if a hydrated phosphate or tartrate baking powder was used.
5. Remove from the tins as soon as taken from the oven. Serve while warm.

PLAIN CAKE II[6]

Yield

As a loaf cake: 9 pieces, 2 inches by 2 inches by $1\frac{1}{2}$ inches; as cupcakes: 11 cupcakes, $2\frac{1}{2}$ inches in diameter and $1\frac{1}{4}$ inches high.

Baking pans

Capacity: 1,100 to 1,200 cubic centimeters (approximately 5 cups).

Pans used in this laboratory:

a) One loaf-cake pan $6\frac{1}{2}$ inches by $6\frac{1}{2}$ inches by $1\frac{1}{2}$ inches.

b) Eleven muffin-pan sections, each of 100-cubic-centimeter capacity.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Butter	53	$\frac{1}{4}$ cup ($\frac{1}{2}$ of a $\frac{1}{4}$-pound section)
or		
Butter	26	2 tablespoons
and		
Hydrogenated fat	25	2 tablespoons
Sugar	150	$\frac{3}{4}$ cup
Eggs		
Yolk	18	1 medium sized
Whites	60	2 medium sized
Cake flour	128	$1\frac{1}{3}$ cups
Baking powder		
S.A.S.–phosphate	5.5	$1\frac{1}{2}$ teaspoons
or		
Anhydrous phosphate	5.4	$1\frac{1}{2}$ teaspoons
or		
Hydrated phosphate	8.0	2 teaspoons
or		
Tartrate	7.5	2 teaspoons
Salt	.....	$\frac{1}{4}$ teaspoon

[6] This cake is a particularly nice modification of Plain Cake I.

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Milk	122	118 cubic centimeters ($\frac{1}{2}$ cup)
Vanilla	.....	$\frac{1}{2}$ teaspoon

Conventional method: Order of work: Detailed form

1. Assemble all ingredients and utensils needed in the preparation of the cake.

   Fit a piece of light-weight oiled or other thin paper into the bottom of the pan; oil the paper and the sides of the pan.

2. (*a*) Weigh or measure the fat. Place it in the mixing bowl. If the room is hot (80° F. or above), set the fat in the refrigerator until the rest of the ingredients are ready.
   b) Weigh or measure the sugar.
   c) Weigh or measure the flour and baking powder. Measure the salt. Mix the three well; then sift them together.
   d) Weigh or measure the milk.
   e) Measure the vanilla; turn it into the milk.

3. Light the oven. Set it at 300° F. for a S.A.S.–phosphate or anhydrous phosphate baking powder; at 350° F. for a hydrated phosphate or tartrate baking powder.

4. Combine the fat, sugar, and egg yolk as follows:
   a) Cream the fat with a wooden spoon until it is very plastic and a light-yellow color.
   b) Add a little (about 1 tablespoon) of the sugar to the fat and beat until the mixture looks fluffy (this will take about 1 minute). Repeat until all the sugar is mixed with the fat. When this has been done, the resulting product should be a light-yellow, fluffy mixture of thoroughly blended fat and sugar, having the general appearance of hard sauce. Remove all material cling-

ing to the spoon. If the room is hot, set the creamed fat and sugar in the refrigerator while the eggs are being separated and the whites beaten.

c) Separate the egg whites from the yolks; place one of the yolks in the fat-sugar mixture, and the whites in a bowl in which they can be beaten conveniently. Beat the whites until they are stiff but not until they lose their shiny appearance.

d) Beat the egg yolk with the fat and sugar until the three are thoroughly combined (30 seconds or more).

5. Combine the remaining ingredients as follows:

a) Add one heaping tablespoon of the mixture of flour, baking powder, and salt to the fat-sugar-egg mixture.

Stir until the flour is dampened (about 10 seconds); then beat for 30 seconds.

The mixing process should be continuous from now until the batter is in the pan. Therefore, be sure that everything needed is at hand.

b) Add about one-fourth, approximately 2 tablespoons, of the milk. With a few gentle strokes of the spoon mix it slightly (not thoroughly) with the other ingredients.

c) Repeat this addition of flour and milk alternately, using the same amounts and the same method of combination as given above, except shorten the beating-period after the dampening of the flour to 10 seconds. End with a portion of flour.

d) When all the flour has been added and the last portion dampened, beat the batter for 1 minute if a S.A.S.–phosphate or anhydrous phosphate, for 30 seconds if a hydrated phosphate, or for 15 seconds if a tartrate, baking powder has been used.

e) Add the beaten egg whites and stir gently but quickly until the mixture can be beaten without spattering (about 5 seconds). Then beat for 25 seconds. Immediately turn the batter into the oiled tins.

The total time elapsing between the beginning of

step *b* and the end of step *e* should not be longer than about 6 minutes.

6. Bake[7] as follows:
   a) For a S.A.S.–phosphate or anhydrous phosphate baking powder:
      (1) Loaf cake—At 300° F. during the first 20 minutes, then at 375° F. for about 25 minutes longer.
      (2) Cupcakes—at 300° F. during the first 10 minutes, then at 375° F. for about 15 minutes longer.
   b) For a hydrated phosphate or tartrate baking powder:
      (1) Loaf cake—at 350° F. during the first 20 minutes, then at 375° F. for about 20 minutes longer.
      (2) Cupcakes—at 350° F. during the first 10 minutes, then at 375° F. for about 15 minutes longer.
7. As soon as the cake is taken from the oven, remove it from the pan and take the paper off the bottom. Place the cake on a rack to cool.

Muffin method

The muffin method of combining the ingredients for this cake is exactly like that for Plain Cake I (p. 96).

PLAIN CAKE III[8]

Yield

As a two-layer cake: 10 "pie-shaped" pieces, $2\frac{1}{4}$ inches across the outer edge; as cupcakes: 16 cupcakes, $2\frac{1}{2}$ inches in diameter and $1\frac{1}{4}$ inches high.

Baking pans

Capacity: 1,600 to 1,700 cubic centimeters (about 7 cups). Pans used in this laboratory:

a) Two layer-cake pans, $8\frac{1}{2}$ inches in diameter by 1 inch high.
b) Sixteen muffin-pan sections, each of 100-cubic-centimeter capacity.

[7] Baking tests are given on p. 92.

[8] This cake is prepared by the modified bakers' method.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Cake flour	168	$1\frac{3}{4}$ cups
Sugar	225	1 cup plus 2 tablespoons
Baking powder		
S.A.S.–phosphate	7.5	2 teaspoons
or		
Anhydrous phosphate	7.3	2 teaspoons
or		
Hydrated phosphate	10.0	$2\frac{1}{2}$ teaspoons
or		
Tartrate	9.0	$2\frac{1}{2}$ teaspoons
Salt	.....	$\frac{1}{2}$ teaspoon
Hydrogenated vegetable shortening	68	$\frac{1}{3}$ cup
Eggs	96	2 medium
Milk	183	177 milliliters ($\frac{3}{4}$ cup)
Vanilla	.....	$\frac{1}{2}$ teaspoon

Modified bakers' method: Order of work

1. Assemble all ingredients and utensils needed in the preparation of the cake.

   Fit a piece of light-weight oiled or other thin paper into the bottom of the pan; oil the paper and the sides of the pan.
2. Weigh or measure the flour, sugar, baking powder, and salt. Mix, and then sift them into a 2-quart mixing bowl.
3. Weigh or measure the shortening—it should be at room temperature. Scrape it into the mixing bowl.
4. Break two medium-sized eggs, and turn them (unbeaten) into the mixing bowl.
5. Weigh or measure the milk. Turn about half of it into the mixing bowl.

6. Stir slowly until the flour is dampened, then vigorously for 2 minutes. Stop once or twice during the stirring and scrape the spoon and the edge of the bowl.
7. Add the rest of the milk and the vanilla and stir for 2 minutes, then turn the batter into the oiled tins.
8. Bake[9] the cake as follows:
   a) For a S.A.S.–phosphate or anhydrous phosphate baking powder:
      (1) Layer cake—at 300° F. during the first 10 minutes, then at 375° F. for about 25 minutes longer.
      (2) Cupcakes—at 300° F. during the first 10 minutes, then at 375° F. for about 15 minutes longer.
   b) For a hydrated phosphate or tartrate baking powder:
      (1) Layer cake—at 350° F. during the first 10 minutes, then at 375° F. for about 20 minutes longer.
      (2) Cupcakes—350° F. during the first 10 minutes, then at 375° F. for about 15 minutes longer.
9. As soon as the cake is taken from the oven, remove it from the tin and take the paper off the bottom. Place the cake on a rack to cool.

SPICE CAKE

Yield

As a loaf cake: 9 pieces, 2 inches by 2 inches by 1½ inches; as cupcakes: 11 cupcakes, 2½ inches in diameter and 1¼ inches high.

Baking pans

Capacity: 1,100 to 1,200 cubic centimeters (approximately 5 cups).

Pans used in this laboratory:

a) One loaf-cake pan 6½ inches by 6½ inches by 1½ inches.
b) Eleven muffin-pan sections, each of 100-cubic-centimeter capacity.

[9] Baking tests are given on p. 92.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Butter	53	¼ cup
or		
Butter	26	2 tablespoons
and		
Hydrogenated fat	25	2 tablespoons
Sugar	150	¾ cup
Eggs		
Yolks	36	2 medium sized
White	30	1 medium sized
Cake flour	128	1⅓ cups
Baking powder		
S.A.S.–phosphate	5.5	1½ teaspoons
or		
Anhydrous phosphate	5.4	1½ teaspoons
or		
Hydrated phosphate	8.0	2 teaspoons
or		
Tartrate	7.5	2 teaspoons
Salt	.....	¼ teaspoon
Milk	122	118 cubic centimeters (½ cup)
Cinnamon	.....	1 teaspoon
Cloves, allspice, nutmeg	.....	½ teaspoon each
or, in place of the above spices, spice mixture[10]	.....	2 teaspoons
Boiling water	.....	1 tablespoon

[10] We have found it very convenient and time-saving to prepare at one time a fairly large quantity of a mixture of spices which can be used in the preparation of this cake and also of gingerbread. This is made by mixing together thoroughly two parts, by measure, of ground cinnamon, and one part each of ground cloves, allspice, and nutmeg. The mixture should be kept in a practically airtight container, such as a jelly glass with a tightly fitting lid.

Conventional method: Order of work: Detailed form

1. Assemble all ingredients and utensils needed in the preparation of the cake.

   Fit a piece of light-weight oiled or other thin paper into the bottom of the pan; oil the paper and the sides of the pan.
2. (*a*) Weigh or measure the fat. Place it in the mixing bowl. If the room is hot (80° F. or above), set the fat in a refrigerator until the rest of the ingredients are ready.
   b) Weigh or measure the sugar.
   c) Weigh or measure the flour and baking powder. Measure the salt. Mix the three well; then sift them together.
   d) Weigh or measure the milk.
3. Light the oven. Set it at 300° F. for a S.A.S.–phosphate or anhydrous phosphate baking powder; at 350° F. for a hydrated phosphate or tartrate baking powder.
4. Combine the fat, sugar, and egg yolks as follows:
   a) Cream the fat with a wooden spoon until it is very plastic and a light-yellow color.
   b) Add a little (about 1 tablespoon) of the sugar to the fat and beat until the mixture looks fluffy (this will take about 1 minute). Repeat until all the sugar is mixed with the fat. When this has been done, the resulting product should be a light-yellow, fluffy mixture of thoroughly blended fat and sugar, having the general appearance of hard sauce. Remove all material clinging to the spoon. If the room is hot, set the creamed fat and sugar in a refrigerator while the eggs are being separated and the white beaten.
   c) Separate the egg whites from the yolks; place the yolks in the fat-sugar mixture, and one of the whites in a bowl in which it can be beaten conveniently. Beat the white until it is stiff but not until it loses its shiny appearance.

d) Beat the egg yolks with the fat and sugar until they are thoroughly combined (30 seconds or more).

5. Combine the remaining ingredients as follows:

a) Put a small quantity of water on the fire to boil; measure the spices; measure the boiling water, and mix with the spices.

b) Beat the moistened spices with the fat-sugar-egg-yolk mixture until they are thoroughly combined (about 30 seconds).

c) Add one heaping tablespoon of the mixture of flour, baking powder, and salt. Stir until the flour is dampened (about 10 seconds), then beat for 30 seconds.

The mixing process should be continuous from now until the batter is in the pan. Therefore, be sure that everything needed is at hand.

d) Add about one-fourth, approximately 2 tablespoons, of the milk. With a few gentle strokes of the spoon mix it slightly (not thoroughly) with the other ingredients.

e) Repeat this addition of flour and milk alternately, using the same amounts and the same method of combination as given above, except shorten the beating-period after the dampening of the flour to 10 seconds. End with a portion of flour.

f) When all the flour has been added and the last portion dampened, beat the batter for 1 minute if a S.A.S.–phosphate or anhydrous phosphate, for 30 seconds if a hydrated phosphate, or for 15 seconds if a tartrate, baking powder has been used.

g) Add the beaten egg white and stir gently but quickly until the mixture can be beaten without spattering (about 5 seconds). Then beat for 25 seconds. Immediately turn the batter into the oiled tins.

The total time elapsing between the beginning of step *d* and the end of step *g* should not be longer than 6 minutes.

6. Bake[11] the cake as follows:
   a) For a S.A.S.–phosphate or anhydrous phosphate baking powder:
      (1) Loaf cake—at 300° F. during the first 20 minutes, then at 375° F. for about 25 minutes longer.
      (2) Cupcakes—at 300° F. during the first 10 minutes, then at 375° F. for about 15 minutes longer.
   b) For a hydrated phosphate or tartrate baking powder:
      (1) Loaf cake—at 350° F. during the first 20 minutes, then at 375° F. for about 20 minutes longer.
      (2) Cupcakes—at 350° F. during the first 10 minutes, then at 375° F. for about 15 minutes longer.
7. As soon as the cake is taken from the oven, remove it from the pan and take the paper off the bottom. Place it on a cake rack to cool.

Muffin method: Order of work

1. Assemble all ingredients and utensils needed in the preparation of the cake. Oil the baking pans—muffin tins are to be preferred. Cakes are readily removed if the pans are lined with paper cups.
2. Weigh or measure the ingredients:

Flour Baking powder Sugar Salt	Mix, then sift together into the mixing bowl
Spices Boiling water	Mix together
Eggs:	For a S.A.S.–phosphate, an anhydrous phosphate, or a hydrated phosphate baking powder, beat the yolks and white together until foamy; for a tartrate baking powder, beat the yolks and white separately, the white until it is stiff.
Milk:	Turn into the egg, or into the egg yolks if the white and yolks were beaten separately.

[11] Baking tests are given on p. 92.

Butter: Melt before weighing or measuring. After weighing or measuring, turn into the egg-milk mixture.

3. Combine the wet and dry ingredients as follows:
   a) Make a well in the center of the dry ingredients.
   b) If a S.A.S.–phosphate, anhydrous phosphate, or hydrated phosphate baking powder was used, turn all the wet ingredients and the moist spices into the well and stir as vigorously as possible until the batter can be beaten without spattering (about 20 seconds). Then beat for 1 minute.

   If a tartrate baking powder was used, turn all the wet ingredients and the moist spices into the well and stir as vigorously as possible until the batter can be beaten without spattering. Then beat for 15 seconds; stir in the beaten egg white and continue beating for 25 seconds.
4. Bake (in muffin pans) at 300° F. for the first 10 minutes, then at 375° F. for about 15 minutes longer if a S.A.S.–phosphate or anhydrous phosphate baking powder was used; at 350° F. for the first 10 minutes, then at 375° F. for about 15 minutes longer, if a hydrated phosphate or tartrate baking powder was used.
5. Remove from the tins as soon as taken from the oven. Serve while warm.

CHOCOLATE CAKE

Yield

As a two-layer cake: 10 "pie-shaped" pieces, $2\frac{1}{4}$ inches across the outer edge; as a loaf cake: 16 pieces, 2 inches by 2 inches by $1\frac{1}{2}$ inches; as cupcakes: 16 cupcakes, $2\frac{1}{2}$ inches in diameter and $1\frac{1}{4}$ inches high.

Baking pans

Capacity: 1,600 to 1,700 cubic centimeters (approximately 7 cups).

Pans used in this laboratory:

a) Two layer-cake pans, $8\frac{1}{2}$ inches in diameter by 1 inch high.
b) One loaf-cake pan, $8\frac{1}{4}$ inches by $8\frac{1}{4}$ inches by $1\frac{1}{2}$ inches.
c) Sixteen muffin-tin sections, each of 100-cubic-centimeter capacity.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Bitter chocolate	57	2 squares
Butter	53	$\frac{1}{4}$ cup
or		
Butter	26	2 tablespoons
and		
Hydrogenated fat	25	2 tablespoons
Sugar	200	1 cup
Eggs		
Yolks	36	2 medium sized
Whites	60	2 medium sized
Cake flour	128	$1\frac{1}{3}$ cups
Baking powder		
S.A.S.-phosphate	5.5	$1\frac{1}{2}$ teaspoons
or		
Anhydrous phosphate	5.4	$1\frac{1}{2}$ teaspoons
or		
Hydrated phosphate	8.0	2 teaspoons
or		
Tartrate	7.5	2 teaspoons
Salt	.....	$\frac{1}{4}$ teaspoon
Milk	183	178 cubic centimeters ($\frac{3}{4}$ cup)
Vanilla	.....	$\frac{1}{2}$ teaspoon

Conventional method: Order of work

1. Assemble all ingredients and utensils needed in the preparation of the cake.

   Fit a piece of light-weight oiled or other thin paper into

the bottom of the pan; oil the paper and the sides of the pan.

2. (*a*) Weigh or measure the chocolate. Place it in a pan from which the melted chocolate can be removed easily (a very shallow pan which has a handle is most convenient), and melt it over hot water. While it is melting, other ingredients may be weighed; but as soon as all of it has melted, it should be removed from the heat and allowed to cool somewhat before using.
   b) Weigh or measure the fat. Place it in the mixing bowl. If the room is hot (80° F. or above), set the fat in the refrigerator until the rest of the ingredients are ready.
   c) Weigh or measure the sugar.
   d) Weigh or measure the flour and baking powder. Measure the salt. Mix the three well; then sift them together.
   e) Weigh or measure the milk.
   f) Measure the vanilla. Turn it into the milk.
3. Light the oven. Set it at 300° F. for a S.A.S.–phosphate or anhydrous phosphate baking powder, at 350° F. for a hydrated phosphate or tartrate baking powder.
4. Combine the fat, sugar, and egg yolks as follows:
   a) Cream the fat with a wooden spoon until it is very plastic and a light-yellow color.
   b) Add a little (about 1 tablespoon) of the sugar to the fat and beat until the mixture looks fluffy (this will take about 1 minute). Repeat until all the sugar is mixed with the fat.

   Remove all material clinging to the spoon.

   If the room is hot, set the creamed fat and sugar in the refrigerator while the eggs are being separated and the whites beaten.
   c) Separate the egg whites from the yolks; place the yolks in the fat-sugar mixture, and the whites in a bowl in which they can be beaten conveniently. Beat the

whites until they are stiff, but not until they lose their shiny appearance.

d) Beat the egg yolks with the fat and sugar until they are thoroughly combined (30 seconds or more).

5. Combine the remaining ingredients as follows:

a) Add the melted chocolate to the mixture of fat, sugar, and egg yolks, and beat until it is thoroughly combined with them (30 seconds or more).

b) Add one heaping tablespoon of the mixture of flour, baking powder, and salt to the mixture of fat, sugar, egg yolks, and chocolate. Stir until the flour is dampened (about 10 seconds); then beat for 30 seconds.

The mixing process should be continuous from now until the batter is in the pan. Therefore, be sure that everything needed is at hand.

c) Add about one-fourth, approximately 3 tablespoons, of the milk. With a few gentle strokes mix it slightly (not thoroughly) with the other ingredients.

d) Repeat this addition of flour and milk alternately, using the same amounts and the same method of combination as given above, except shorten the beating-period after the dampening of the flour to 10 seconds. End with a portion of flour.

e) When all the flour has been added and the last portion dampened, beat the batter for 1 minute if a S.A.S.–phosphate or anhydrous phosphate, for 30 seconds if a hydrated phosphate, or for 15 seconds if a tartrate, baking powder has been used.

f) Add the beaten whites and stir gently but quickly until the mixture can be beaten without spattering—about 5 seconds. Then beat for 25 seconds.

g) Immediately turn the batter into the oiled tins.

The total time elapsing between the beginning of step *c* and the end of step *g* should not be longer than about 6 minutes.

6. Bake[12] as follows:
   a) For a S.A.S.–phosphate or anhydrous phosphate baking powder:
      (1) Layer cake—at 300° F. during the first 10 minutes, then at 350° F. for about 25 minutes longer.
      (2) Loaf cake—at 300° F. during the first 20 minutes, then at 350° F. for about 25 minutes longer.
      (3) Cupcakes—at 300° F. during the first 10 minutes, then at 350° F. for about 20 minutes longer.
   b) For a hydrated phosphate or tartrate baking powder:
      (1) Layer cake—at 350° F. for about 35 minutes.
      (2) Loaf cake—at 350° F. for about 45 minutes.
      (3) Cupcakes—at 350° F. for about 30 minutes.
7. As soon as the cake is taken from the oven, remove it from the pan and take the paper off the bottom. Place the cake on a rack to cool.

WHITE CAKE

Yield

As a two-layer cake: 10 "pie-shaped" sections, $2\frac{1}{4}$ inches across the outer edge; as a loaf cake: 16 pieces, 2 inches by 2 inches by $1\frac{1}{2}$ inches.

Baking pans

Capacity: 1,700 cubic centimeters (approximately 7 cups). Pans used in this laboratory:

a) Two layer-cake pans, $8\frac{1}{2}$ inches in diameter by 1 inch high.
b) One loaf-cake pan, $8\frac{1}{4}$ inches by $8\frac{1}{4}$ inches by $1\frac{1}{2}$ inches.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Butter	53	$\frac{1}{4}$ cup
Hydrogenated fat	51	$\frac{1}{4}$ cup
Sugar	200	1 cup

[12] Baking tests are given on p. 92.

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Egg whites	114	$\frac{1}{2}$ cup (whites from about 4 medium-sized eggs)
Cake flour	168	$1\frac{3}{4}$ cups
Baking powder		
S.A.S.–phosphate	11.0	3 teaspoons
or		
Anhydrous phosphate	10.8	3 teaspoons
or		
Hydrated phosphate	16.0	4 teaspoons
or		
Tartrate	14.5	4 teaspoons
Salt	.....	$\frac{1}{4}$ teaspoon
Milk	122	118 cubic centimeters ($\frac{1}{2}$ cup)
Lemon extract	.....	1 teaspoon
Almond extract	.....	$\frac{1}{2}$ teaspoon

Conventional method: Order of work

1. Assemble all ingredients and utensils needed in the preparation of the cake.

   Fit a piece of light-weight oiled or other thin paper into the bottom of the pan; oil the paper and the sides of the pan.

2. (*a*) Weigh or measure the fat. Place it in the mixing bowl. If the room is hot (80° F. or above), set the fat in the refrigerator until the rest of the ingredients are ready.

   b) Weigh or measure the sugar.

   c) Weigh or measure the flour and baking powder. Measure the salt. Mix the three well; then sift them together.

   d) Weigh or measure the milk.

   e) Measure the lemon and almond extracts. Turn them into the milk.

3. Light the oven. Set it at 300° F. for a S.A.S.–phosphate or an anhydrous phosphate baking powder, at 350° F. for a hydrated phosphate or tartrate baking powder.
4. Combine the fat and sugar as follows:
   a) Cream the fat with a wooden spoon until it is very plastic and a light-yellow color.
   b) Add a little (about 1 tablespoon) of the sugar to the fat and beat until the mixture looks fluffy (this will take about 1 minute). Repeat until all the sugar is mixed with the fat. When this has been done, the resulting product should be a light-yellow, fluffy mixture of thoroughly blended fat and sugar, having the general appearance of hard sauce.

      Remove all material clinging to the spoon.

      If the room is hot, set the creamed fat and sugar in the refrigerator while the eggs are being separated and the whites beaten.
5. Separate the egg whites from the yolks; weigh or measure them; place them in a bowl in which they can be beaten conveniently and beat them until they are stiff but not until they lose their shiny appearance.
6. Combine the remaining ingredients as follows:
   a) Add one heaping tablespoon of the mixture of flour, baking powder, and salt to the fat-sugar mixture. Stir until the flour is dampened (about 10 seconds); then beat for 30 seconds.

      The mixing process should be continuous from now until the batter is in the pan. Therefore, be sure that everything needed is at hand.
   b) Add about one-fifth, approximately $1\frac{1}{2}$ tablespoons, of the milk. With a few gentle strokes mix it slightly (not thoroughly) with the other ingredients.
   c) Repeat this addition of flour and milk alternately, using the same amounts and the same methods of combination as given above, except shorten the beating-

period after the dampening of the flour to 10 seconds. End with a portion of the flour.

d) When all the flour has been added and the last portion dampened, beat the batter for 1 minute if a S.A.S.–phosphate or anhydrous phosphate, for 30 seconds if a hydrated phosphate, or for 15 seconds if a tartrate, baking powder has been used. The batter will be very thick.

e) Add the beaten whites and stir gently but quickly until the mixture can be beaten without spattering—about 5 seconds. Then beat for 25 seconds. Immediately turn the batter into the oiled tins.

The total time elapsing between the beginning of step *b* and the end of step *e* should not be longer than about 6 minutes.

7. Bake[13] as follows:
   a) For a S.A.S.–phosphate or anhydrous phosphate baking powder:
      (1) Layer cake—at 300° F. during the first 10 minutes, then at 375° F. for about 20 minutes longer.
      (2) Loaf cake—at 300° F. during the first 20 minutes, then at 375° F. for about 25 minutes longer.
   b) For a hydrated phosphate or tartrate baking powder:
      (1) Layer cake—at 350° F. during the first 10 minutes, then at 375° F. for about 15 minutes longer.
      (2) Loaf cake—at 350° F. during the first 20 minutes, then at 375° F. for about 20 minutes longer.
8. As soon as the cake is taken from the oven, remove it from the pan and take the paper off the bottom. Place the cake on a rack to cool.

GINGERBREAD

Yield

As cupcakes: 11 cupcakes, $2\frac{1}{2}$ inches in diameter and $1\frac{1}{4}$ inches high; as a loaf cake: 9 pieces, 2 inches by 2 inches by $1\frac{1}{2}$ inches.

[13] This cake shrinks badly if overbaked. Baking tests are given on p. 92.

Baking pans

Capacity: 1,100 to 1,200 cubic centimeters (approximately 5 cups).

Pans used in this laboratory:

a) Eleven muffin-pan sections, each of 100-cubic-centimeter capacity.

b) One loaf-cake pan $6\frac{1}{2}$ inches by $6\frac{1}{2}$ inches by $1\frac{1}{2}$ inches.

Approximate preparation time after a few trials

Ten minutes, exclusive of the 25–30-minute baking period.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	141	$1\frac{1}{4}$ cups
or		
Soft-wheat family *or* cake	168	$1\frac{3}{4}$ cups
Baking powder (any type)	4.0	1 teaspoon
Salt	.....	$\frac{1}{4}$ teaspoon
Ginger	.....	1 teaspoon
Spice mixture[14]	.....	4 teaspoons
or		
Cinnamon	.....	2 teaspoons
and		
Cloves and allspice	.....	1 teaspoon, each
Soda	3.5	1 teaspoon
Molasses (a light-colored cooking[15])	163	$\frac{1}{2}$ cup
Sugar	50	$\frac{1}{4}$ cup
Fat (melted or a liquid fat)	53	$\frac{1}{4}$ cup
Egg (whole)	48	1 medium sized
or		
Egg yolk	36	2 medium sized
Boiling water	118	$\frac{1}{2}$ cup

[14] See p. 104, n. 10.

[15] The ones which we happen to have used are Dove and Brer Rabbit Green Label brands.

Order of work

1. Assemble all ingredients and utensils needed. Oil the baking pans well—muffin pans are preferable.
2. Light the oven. Set it at 325° F.
3. (*a*) Weigh or measure the flour and baking powder. Measure the salt. Mix the three well; then sift them together.
   b) Measure the spices and soda. Place them in a small bowl and mix.
   c) Weigh or measure the molasses, sugar, and melted fat. Turn them into the mixing bowl and mix. Add the beaten egg and beat until it is well combined with the molasses, sugar, and fat (about 20 seconds).
4. Put some water on to boil.
5. Combine the remaining ingredients as follows:
   a) Add the mixture of flour, baking powder, and salt all at one time to the molasses-sugar-fat-egg mixture. Stir until the dry ingredients are just dampened (about ½ minute).
   b) Measure the boiling water; quickly mix it with the spices and soda; and then turn this mixture into the mixture of molasses, sugar, fat, flour, and baking powder. Stir as vigorously as possible until the batter can be beaten without spattering (about 10 seconds). Then beat for 45 seconds if a tartrate, or for 1 minute if a phosphate or S.A.S.–phosphate, powder has been used.

      The batter is very thin.

   c) Immediately turn the batter into the pan.
6. Bake[16] as follows:
   a) Cupcakes—at 325° F. for about 25 minutes.
   b) Loaf cake—at 325° F. for about 30 minutes.

[16] Baking tests are given on p. 92.

HERMITS

Yield

One and one-half dozen cookies about $2\frac{1}{4}$ inches in diameter.

Baking pans

One baking sheet with about 240 square inches of surface. The one used in this laboratory is 14 by 17 inches.

Approximate preparation time after a few trials

Ten minutes, exclusive of the baking period of about 15 minutes.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Raisins	80	$\frac{1}{2}$ cup
Flour		
Hard-wheat family	127	$1\frac{1}{8}$ cups
or		
Soft-wheat family *or* cake	144	$1\frac{1}{2}$ cups
Baking powder		
S.A.S.–phosphate	5.5	$1\frac{1}{2}$ teaspoons
or		
Anhydrous phosphate	5.4	$1\frac{1}{2}$ teaspoons
or		
Hydrated phosphate	8.0	2 teaspoons
or		
Tartrate	7.5	2 teaspoons
Sugar	100	$\frac{1}{2}$ cup
Salt	.....	$\frac{1}{4}$ teaspoon
Spice mixture	.....	2 teaspoons
or		
Cinnamon	.....	1 teaspoon
and		
Cloves and allspice	.....	$\frac{1}{2}$ teaspoon, each
Water (boiling)	.....	2 teaspoons
Egg	48	1 medium sized
Milk	15	15 cubic centimeters (1 tablespoon)

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Butter (melted)	55	$\frac{1}{4}$ cup
or		
Other fat (melted or a liquid fat)	53	$\frac{1}{4}$ cup

Order of work

1. Assemble all ingredients and utensils needed in the preparation of the cookies. Oil the baking sheets.
2. Light an oven. Set it at 375° F.
3. (*a*) Cut the raisins into small pieces.
   b) Weigh or measure the flour, baking powder, and sugar. Measure the salt. Mix them well; then sift them into the mixing bowl.
   c) Put a small quantity of water on to boil. Measure the spices; and as soon as the water is hot, mix 2 teaspoons of it with the spices.
   d) Beat the egg until it is foamy; measure the milk and turn it into the egg.
   e) Weigh or measure the melted fat. Turn it slowly into the egg-milk mixture. Stir while it is being added.
4. Just as soon as the fat has been poured into the egg and milk, pour this mixture and then the moist spices into the dry ingredients. Stir as vigorously as possible until the dry ingredients are dampened (about 30 seconds); add the raisins and continue stirring for about 30 seconds.
5. Pick up in a teaspoon as much of the dough as the spoon will hold. Scrape it from the spoon onto the baking sheet, piling it up rather than spreading it out. Transfer the rest of the dough to the baking sheet in a similar manner. Leave at least $1\frac{1}{2}$ inches between cookies.
6. Bake at 375° F. until the cookies are brown (about 15 minutes). The cookies are done when a toothpick stuck into the center comes out clean.

OATMEAL-DATE-NUT COOKIES

Yield

Three dozen cookies about $1\frac{1}{2}$ inches in diameter.

Baking pans

Two baking sheets of about 140 square inches of surface. The ones used in this laboratory are 10 by 14 inches.

Approximate preparation time after a few trials

Fifteen minutes, exclusive of a 12–15-minute baking period.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	84	$\frac{3}{4}$ cup
or		
Soft-wheat family *or* cake	96	1 cup
Baking powder (any type)	4.0	1 teaspoon
Salt	.....	$\frac{1}{4}$ teaspoon
Rolled oats	75	1 cup
Dates or raisins	125	$\frac{3}{4}$ cup (about $\frac{1}{2}$ of a 10-ounce package of pitted dates or $\frac{1}{3}$ of a 15-ounce package of seeded raisins)
Shelled nuts	55	$\frac{1}{2}$ cup ($\frac{1}{8}$ pound)
Butter	105	$\frac{1}{2}$ cup ($\frac{1}{4}$ pound)
or		
Butter	55	$\frac{1}{4}$ cup
and		
Solid fat	51	$\frac{1}{4}$ cup
Light-brown sugar	98	$\frac{1}{2}$ cup
Milk	81	$\frac{1}{3}$ cup (79 cubic centimeters)

Order of work

1. Assemble all ingredients and utensils needed in the preparation of the cookies. The baking sheets need not be oiled.
2. Light the oven. Set it at 375° F.
3. Weigh or measure the rolled oats and milk. Mix the oats with all but 1 tablespoon of the milk.
4. Weigh or measure the flour, baking powder, and salt; mix and then sift together.
5. Cut the dates or raisins and nuts into small pieces, weigh or measure, and turn into the mixture of flour, baking powder, and salt. Mix with the hands until the pieces are separated and floured.
6. Weigh or measure the butter and brown sugar, the latter rolled or sifted if necessary to remove lumps. Add the sugar to the butter all at once and mix the two together. This need not take more than 1 minute if the butter has been allowed to stand at room temperature until soft, since the mixture need not be creamed until fluffy as in cakes.
7. Add the dry ingredients, the oats, and the rest of the milk to the butter-sugar mixture, and mix until all are well combined (about 2 minutes).
8. Transfer the dough to the baking sheet by rounding teaspoonfuls. In scraping it from the spoon, pile it up rather than spread it out. Leave about $1\frac{1}{2}$ inches between cookies.
9. Bake at 375° F. until the cookies are brown (about 15 minutes).

SHORTBREAD

Yield

About 3 dozen cookies, 2 inches in diameter.

Baking pans

Two baking sheets of about 140 square inches of surface. The ones used in this laboratory are 10 by 14 inches.

Approximate preparation time after a few trials

Twenty minutes, exclusive of a standing period of about 20 minutes and a baking period of about 12 minutes. This time may be shortened somewhat by cutting the cookies into squares or rectangles with a knife.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Butter	210	1 cup ($\frac{1}{2}$ pound)
Light-brown sugar	98	$\frac{1}{2}$ cup
Flour		
Hard-wheat family	255	$2\frac{1}{4}$ cups
or		
Soft-wheat family *or* cake	300	3 cups plus 2 tablespoons

Order of work

1. Assemble all ingredients and utensils needed in the preparation of the cookies. The baking sheet need not be oiled.
2. Weigh or measure the fat, sugar, and flour. Place the fat in the mixing bowl. If the sugar is lumpy, roll or sift out the lumps.
3. Combine the fat and sugar as follows:
   a) Cream the fat with a wooden spoon until it is very plastic and a light-yellow color.
   b) Add a little (about 1 tablespoon) of the sugar to the fat and beat until the mixture looks fluffy (this will take about 1 minute). Repeat until all the sugar is mixed with the fat. When this has been done, the resulting product should be a light-yellow fluffy mixture of thoroughly blended fat and sugar, having the general appearance of hard sauce.

   Remove all material clinging to the spoon.
4. Add the flour in four portions and mix well after each addition (about 1 minute).
5. Divide the dough into two approximately equal parts and mold these with the hands until all cracks have disap-

peared. Put the pieces of dough back into the mixing bowl and let stand in the refrigerator until stiffened, 15 to 20 minutes.

6. Light the oven, and set the regulator at 375° F.
7. Roll the dough between sheets of waxed paper or on a bread board. (The first method is much to be preferred for the beginner).

   To roll on waxed paper, place a portion of the dough on a piece of heavy waxed paper about a foot square and cover it with another sheet of the same size and roll it to a thickness of $\frac{1}{4}$ inch.

   To roll on a board, dust the board and rolling pin with flour—not more than $1\frac{1}{2}$ tablespoons of flour should be used in rolling all the dough (probably 3 separate rollings)—place one-half of the dough on the floured portion and roll to a thickness of $\frac{1}{4}$ inch. During rolling, the dough should be moved frequently from one place to another on the board so that there will be no tendency for it to stick, thereby becoming difficult, if not impossible, to transfer to the baking sheet. The faster one works during the rolling and the cooler the room, the less trouble one will have with sticking.
8. Cut the cookies with a cutter which has been lightly floured by dipping it into a bowl of flour and tapping it on the edge of the bowl to remove excess flour. Be sure to cut clear through the dough to the paper or board.
9. Remove the cookies from the waxed paper or board by means of a small flexible spatula. To do this, slip the side, not the end, of the spatula under the cookies and place them on the baking sheet about $\frac{1}{2}$ inch apart. Bake at 375° F. until brown (about 12 minutes).
10. Gather together the dough left from the cutting and return it to the refrigerator.
11. Repeat the rolling, cutting, and baking with the other half of the dough.

12. Mix all the remaining dough by cutting it into small pieces and pressing these together into a smooth ball. If the ball seems softer than those worked with previously, return it to the refrigerator for a few minutes (5 or 10). Roll, cut, and bake as before.

BUTTER COOKIES

Yield

Five dozen cookies about 2 inches in diameter.

Baking pans

Two baking sheets of about 240 square inches of surface. The ones used in this laboratory are 14 by 17 inches.

Approximate preparation time after a few trials

Twenty minutes exclusive of a standing period of about 20 minutes and of a 10–12-minute baking period. This time may be shortened somewhat by cutting the cookies into squares or rectangles with a knife.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	198	$1\frac{3}{4}$ cups
or		
Soft-wheat family *or* cake	240	$2\frac{1}{2}$ cups
Baking powder (any type)	4.0	1 teaspoon
Salt	.....	$\frac{1}{4}$ teaspoon
Butter	105	$\frac{1}{2}$ cup ($\frac{1}{4}$ pound)
Sugar	100	$\frac{1}{2}$ cup
Eggs	48	1 medium sized
Milk	15	1 tablespoon (15 cubic centimeters)
Vanilla	.....	$\frac{1}{2}$ teaspoon
Nut-meats, very finely chopped, if desired	29	$\frac{1}{4}$ cup

Order of work

1. Assemble all ingredients and utensils needed in the preparation of the cookies. The baking sheet need not be oiled.
2. Weigh or measure the flour, baking powder, and salt; mix and then sift them together.
3. Weigh or measure the butter and sugar. Add the sugar to the butter all at once, and mix the two together. This need not take more than 1 minute if the butter has been allowed to stand at room temperature until soft, since the mixture need not be creamed until fluffy as in cakes.
4. Beat the egg until foamy. Add it to the fat-sugar mixture and beat until the ingredients are well combined (about 1 minute).
5. Weigh or measure the milk and vanilla. Add them and about one-half of the dry ingredients to the sugar-butter-egg combination and beat until all are well mixed together (about 1 minute). Add the rest of the dry ingredients and again beat until all are well combined (about 1 minute).
6. Divide the dough into two approximately equal parts and mold these with the hands until all cracks have disappeared. Put the pieces of dough back into the mixing bowl and let stand in the refrigerator until stiffened, 15–20 minutes.
7. Light the oven, and set the regulator at 375° F.
8. Roll the dough between sheets of waxed paper, or on a bread board. (The first method is much to be preferred for the beginner.)

   To roll on waxed paper, place a portion of the dough on a piece of heavy waxed paper about a foot square and cover it with another sheet of the same size and roll to a thickness of $\frac{3}{16}$ inch.

   To roll on a board, dust the board and rolling pin with flour—not more than $1\frac{1}{2}$ tablespoons of flour should be used in rolling all of the dough (probably 3 separate rollings)—place one-half of the dough on the floured portion

and roll to a thickness of $\frac{3}{16}$ inch. During rolling, the dough should be moved frequently from one place to another on the board so that there will be no tendency for it to stick, thereby becoming difficult, if not impossible, to transfer to the baking sheet. The faster one works during rolling and the cooler the room, the less trouble one will have with sticking.

9. Cut the cookies with a cutter which has been lightly floured by dipping it into a bowl of flour and tapping it on the edge of the bowl to remove excess flour.

   Be sure to cut clear through the dough to the paper or board.

10. Remove the cookies from the waxed paper or board by means of a small flexible spatula. To do this, slip the side, not the end, of the spatula under the cookies and place them on the baking sheet about $\frac{1}{2}$ inch apart. Bake at 375° F. until brown (about 10 minutes).

11. Gather together the dough left from the cutting and return it to the refrigerator.

12. Repeat the rolling, cutting, and baking with the other half of the dough.

13. Mix all the remaining dough by cutting it into small pieces and pressing these together into a smooth ball. If the ball seems softer than those worked with previously, return it to the refrigerator for a few minutes (5 or 10). Roll, cut, and bake as before.

CHAPTER V

ANGEL-FOOD AND SPONGE CAKES

THE chief difficulty in making angel-food and sponge cakes—the two types which contain no shortening—is to get the egg whites well combined with the other ingredients without, at the same time, stirring out the air in the beaten whites. It is the expansion of air which makes the cake light; hence, if it is lost, the cake will be compact and heavy. On the other hand, if the egg whites are not well mixed with the other ingredients, the cake will be coarse and of uneven texture. The knack here consists, then, in being able to do much mixing with gentle movements. This point is well illustrated by the angel cakes pictured in Figures 37, 38, and 39. All of these cakes were made from the same proportion of weighed ingredients and all were put together in the same period of time, yet how different are the results! The cake of Figure 37 was made by a person who could fold gently but effectively—that is, she could really get the ingredients combined by gentle movements. This cake was excellent in every respect; it was very light, having about twice the volume of the batter from which it was made; it had a fine grain and was very tender. The cake of Figure 38 was made by a student who used a choppy, up-and-down movement which did not really mix the ingredients but served only to stir out the air, with the result that her cake, as the picture shows, was very coarse in texture and of a small volume. The third cake in the series (Fig. 39) was made by a person with a "heavy hand" who

FIG. 37.—Angel cake in which the ingredients were thoroughly combined by gentle movements. Note the fine, even grain and large volume.

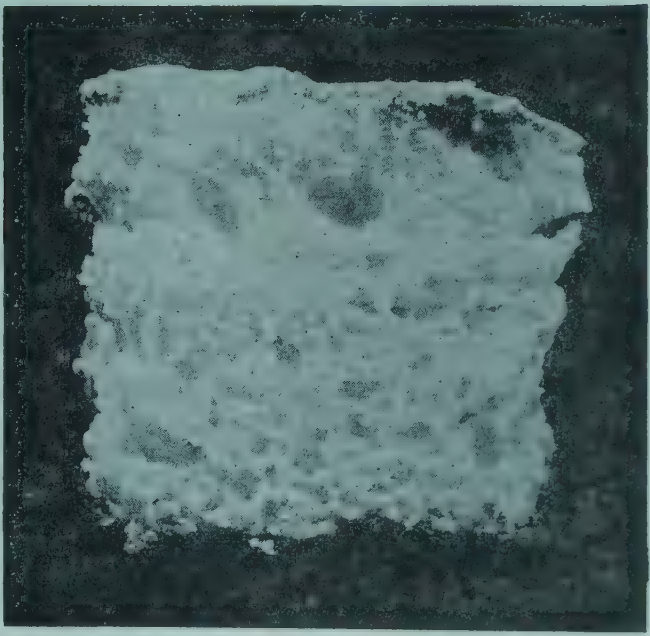


FIG. 38.—Angel cake in which the ingredients were incompletely combined. Note the small volume and coarse grain, as shown by the many large holes.

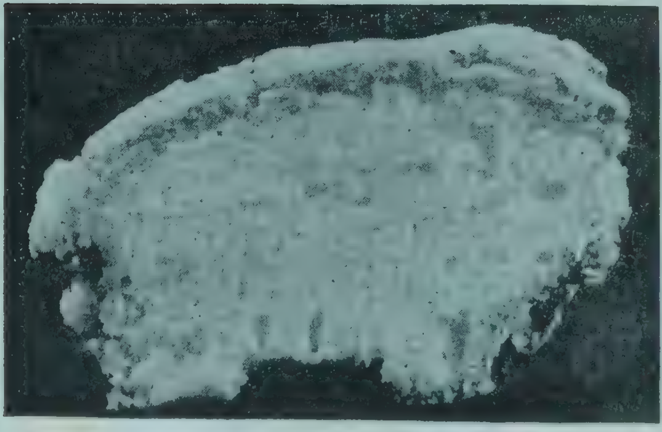


FIG. 39.—Angel cake in which the ingredients were roughly handled. Note the compact, soggy appearance and the small volume.

went at the process with something of the vigor required for turning an ice-cream freezer. In this rough handling, the air was lost; hence the cake was of small volume and quite compact and soggy.

In the section on manipulation we have described the folding process we use in combining the egg whites with the other ingredients in angel and sponge cakes. We realize, however, that what we have said can be interpreted in a number of ways, depending on the reader's experience or lack of it in making cakes. It is, indeed, quite possible for the beginner's first cake to be a sad failure in spite of her best efforts. If it is, we hope that, by matching it with one of our poor ones and re-reading the directions, she can tell what is wrong with it and what to do or leave undone in making the next one. Thus, if her cake looks like the one in Figure 38, she has not done enough of the right kind of folding; whereas if it looks like that in Figure 39, she has committed a common error and folded so long, or, more likely, so roughly, as to remove most of the air.

INGREDIENTS

Cake flour and finely granulated sugar are especially desirable in angel-food and sponge cakes, for both contribute much toward lightness and tenderness.

Cream of tartar or other acid[1] appears to be an essential ingredient in angel cake and a desirable one in sponge cake. Without acid, angel cake is cream colored rather than white and tends to shrink during the last few minutes of baking, so that the volume after baking is but little greater than before.

MANIPULATION OF INGREDIENTS

As already stated, an essential step in preparing both angel-food and sponge cakes is the folding-together of the in-

[1] M. A. Barmore, *The Influence of Chemical and Physical Factors on Egg White Foams* (Colorado Agr. Exper. Sta. Tech. Bull. 9 [1934]); E. Grewe and A. M. Child, "The Effect of Acid Potassium Tartrate as an Ingredient in Angel Cake," *Cereal Chemistry*, VII (1930), 245.

gredients. The process as we have used it may be described as follows:

Tip the bowl slightly toward the right hand and, with the bottom of the wire egg-whip held near and parallel to the side of the bowl, gently cut down through the egg whites. As the bottom of the bowl is approached, gradually shift the position of the egg-whip until it is brought along parallel to the bottom; then, as the opposite side of the bowl is approached, again shift the position of the egg-whip so that, as it is brought up, it is parallel to that side. When the whip comes to the surface, turn it upside down so that it faces the bottom of the bowl. At the same time, carry it across to the other side of the bowl, holding it just above the surface of the mixture and moving it gently to avoid snapping off the mass of material clinging to it. This whole process, which takes approximately 5 seconds, constitutes one complete revolution of the whip and is the essential movement in our method of folding. Each time it is made, the bowl should be rotated through an angle of about 45°, thus bringing a new portion of the mixture into contact with the whip at each of its revolutions.

For angel cakes, the folding process begins with the addition of the first portion of flour and sugar to the egg whites and is repeated after the addition of each successive portion. Finally, after the ingredients are seemingly combined, the folding movement is continued for a short time longer—as we work, for about $\frac{1}{2}$ minute.

For sponge cake, folding begins with the addition of the beaten egg whites and flour to the mixture of egg yolks, sugar, and water and is continued after the addition of each portion, including the last one, until no flecks of egg white are visible.

If the folding is very *gently* done, there seems to be no particular danger of overmixing in any reasonable period of time; but rough handling, even for a short time, is disastrous, as can be seen by looking at the angel cake shown in Figure 39.

DIRECTIONS FOR THE PREPARATION OF ANGEL-FOOD AND SPONGE CAKES

ANGEL-FOOD CAKE[2]

Yield

Twelve "pie-shaped" pieces, each 2 inches across the outer edge.

Utensils

A 3-quart, heavy mixing bowl, similar in shape to the one shown in Figure 25, page 59.

One baking pan, capacity 3,000 cubic centimeters (approximately $12\frac{2}{3}$ cups). The one used in this laboratory is $8\frac{1}{2}$ inches in diameter by $3\frac{1}{2}$ inches tall and has a tube extending through the center.

Approximate preparation time after a few trials

Twenty-five minutes, exclusive of the 40-min. baking period.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Cake flour	96	1 cup
Fine granulated sugar	300	$1\frac{1}{2}$ cups
Egg whites (from fresh eggs)	285	$1\frac{1}{4}$ cups (whites from about 10 medium-sized eggs)
Salt	...	$\frac{1}{4}$ teaspoon
Cream of tartar	...	1 teaspoon
Vanilla	...	$\frac{1}{2}$ teaspoon

[2] Half of this recipe may be made according to the same directions. Convenient utensils are: a $1\frac{1}{2}$-quart, heavy mixing bowl, similar in shape to that shown in Figure 25; a baking pan of 1,500 cubic centimeters (approximately $6\frac{1}{3}$ cups) capacity (the one used in this laboratory is $6\frac{3}{4}$ inches in diameter by 3 inches high and has a tube extending through the center). The baking period will be about 30 minutes.

Order of work: Detailed form

1. Assemble the ingredients and utensils necessary in the preparation of the cake. *Do not oil the baking pan.*
2. (*a*) Weigh or measure the flour.
   b) Weigh or measure the sugar, then mix about two-thirds of it with the flour. (This mixture is more easily folded with the whites than is flour alone. The rest of the sugar will be beaten into the egg whites; see step 4*a*.)
   c) Weigh or measure the egg whites, then place them in the mixing bowl.
   d) Measure the salt and cream of tartar.
3. Light the oven; set it at 350° F.
4. Combine the ingredients as follows:
   a) Sift the salt and cream of tartar over the surface of the egg whites and, with a double rotary egg-beater, beat until foamy. Sprinkle about 2 tablespoons of the sugar over the surface and beat until it has disappeared (about 10 seconds). Repeat with the rest of the sugar, 2 tablespoons at a time. After the last addition, add the vanilla and beat until the whites are just stiff enough to hold the peak formed when the egg-beater is lifted out of the mixture.
   b) Sift a thin layer (about 2 tablespoons) of the flour-sugar mixture over the entire surface of the whites; then fold until it disappears. (This will take about 15 seconds.) For a description of the folding process see page 129.
   c) Repeat this folding process for the rest of the flour-sugar mixture, sifting only about 2 tablespoons at one time over the egg whites. After the addition of the last portion, fold for 30 seconds.
   d) Pour the batter into the cake pan as soon as the fold-

ing has been completed. Lift the last portion lightly from the bowl into the pan, being careful not to stir it.

5. Bake at 350° F. for about 40 minutes. The tests by which one may tell when the cake is done are the same as the tests for butter cakes and are given on page 92.
6. After removing from the oven, immediately turn the cake pan upside down and let it remain so until the cake is cold. There should be an air space between the edge of the pan and the table. If the pan is not equipped with stands, it may be suspended between two pans.

Order of work: Abbreviated form

If the person who makes this cake decides to measure the ingredients, a résumé of the directions is somewhat as follows:

1. Measure the ingredients:

Flour	1 cup	Add two-thirds of the sugar to the flour; mix
Sugar	$1\frac{1}{2}$ cups	
Egg whites	$1\frac{1}{4}$ cups	Add salt and cream of tartar to the egg whites
Salt	$\frac{1}{4}$ teaspoon	
Cream of tartar	1 teaspoon	
Vanilla	$\frac{1}{2}$ teaspoon	

2. Light oven; set at 350° F.
3. Beat the egg whites, salt, and cream of tartar with a double rotary egg-beater until foamy.
4. Beat the sugar, two tablespoons at a time, into the egg whites, then add the vanilla and continue beating until the mixture has become just stiff enough to hold a point when the egg-beater is lifted out of it.
5. Fold in the sugar-flour mixture, two tablespoons at a time, using about 15 seconds for folding after each addition except the last, for which use 30 seconds.
6. Bake for about 40 minutes.
7. Upon removal from the oven, invert tin and let it remain so until the cake is cool.

SPONGE CAKE

Yield

Twelve "pie-shaped" pieces, each 2 inches across the outer edge.

Utensils

A 3-quart, heavy mixing bowl, similar in shape to the one shown in Figure 25, page 59.

One baking pan: capacity, 3,000 cubic centimeters (approximately $12\frac{2}{3}$ cups). The one used in this laboratory is $8\frac{1}{2}$ inches in diameter by $3\frac{1}{2}$ inches tall and has a tube extending through the center.

Approximate preparation time after a few trials

One-half hour, exclusive of a short standing period and of the baking period.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Cake flour	120	$1\frac{1}{4}$ cup
Fine granulated sugar	250	$1\frac{1}{4}$ cup
Eggs		
Yolks	108	6 yolks } from medium-sized eggs
Whites	180	6 whites } from medium-sized eggs
Salt	...	$\frac{1}{4}$ teaspoon
Cream of tartar	...	1 teaspoon
Boiling water	...	4 tablespoons
Vanilla	...	$\frac{3}{4}$ teaspoon

Order of work: Detailed form

1. Assemble the ingredients and utensils needed in the preparation of the cake. *Do not oil the baking pan.*
2. (*a*) Weigh or measure the flour.
   b) Weigh or measure the sugar.

   c) Separate the whites from the yolks; place the yolks in the mixing bowl, and the whites in a bowl in which they can be beaten conveniently.
   d) Measure the salt and cream of tartar.
3. Light the oven; set it at 350° F.
4. Combine the egg yolks, half of the sugar, and hot water as follows:
   a) Put some water on to boil.
   b) Beat the egg yolks with a double rotary egg-beater until they are very light yellow in color and are so stiff that the beater is difficult to turn. This will probably take 2–3 minutes.
   c) Add half of the sugar in four portions, approximately 3 tablespoons each. After each addition, beat with the egg-beater until the mixture thickens (about 10 seconds). When all the sugar has been added, the mixture should be so thick that it will hold its shape.
   d) Add the boiling water in four portions, a tablespoonful each, and beat about $\frac{1}{2}$ minute after each addition. Let this mixture stand until it is cool.
5. While this mixture cools, sift the salt, cream of tartar, and remaining sugar over the surface of the egg whites and beat with a wire egg-whip (which is to be used later for folding in the whites) until they are just stiff enough to hold a point when the egg-beater is lifted out of them. This will probably take 2–3 minutes.
6. Combine the rest of the ingredients as follows:
   a) Beat the egg-sugar-water mixture until it is so stiff that the beater turns with great difficulty. This will take about 2 minutes if the mixture is cool when the beating is started; 3 or more minutes if it is not.
   b) Place the vanilla and about one-sixth of the egg white on top of the egg-yolk mixture. Sift about one-sixth of the flour (that is, a heaping tablespoon) over the surface.

c) Fold with a wire egg-whip (with the motion described on p. 129) until the white and flour have disappeared. This probably will take 45 seconds to 1 minute.

d) Repeat with each of the other sixths of egg white and flour, using the same folding time as before.

e) Immediately turn the batter into the pan.

7. Bake at 350° F. for about 50 minutes, or until the crust is a golden brown and the cake springs back into place after being lightly touched with a finger tip.
8. Immediately after removing from the oven, turn the pan upside down (an air space should be left between the pan and the table top), and leave it so until the cake is cool.

CHAPTER VI

BAKING-POWDER BISCUITS

GOOD biscuits served piping hot, so hot that the butter melts the minute it touches them, are a great delicacy, as everybody will agree. They are, moreover, the quickest and easiest to make of all the batter and dough series, once one has acquired the so-called "knack" of making them. Without this knack, however, they give more trouble than anything else, with the possible exception of doughnuts. To be convinced of this, one has only to think of the awful products turned out by nearly all beginners and, indeed, by more than a few old hands at the job. Some of these biscuits are hard and leathery, others dry and crumbly, still others soft and doughy; but all are equally objectionable. Strange as it may seem, all these and also the best of biscuits can be made from one and the same ingredients in supposedly the same proportions. Failure or success depends upon the cook's method of measuring and combining the materials. Doing this in such a way as to produce good products constitutes the so-called "knack" of a good cook. How to do it for biscuits will be discussed presently. First, however, let us have clearly in mind what we mean by "good" biscuits—just what sort of product we are striving to obtain.

CHARACTERISTICS OF GOOD BISCUITS

Good biscuits are very light, the baked ones being two to three times the volume of the unbaked. They are symmetrical in shape; that is, they rise evenly into almost perfect right cylinders with vertical sides and level tops, and they show no tendency to bulge out at one side or the other or to flatten out in

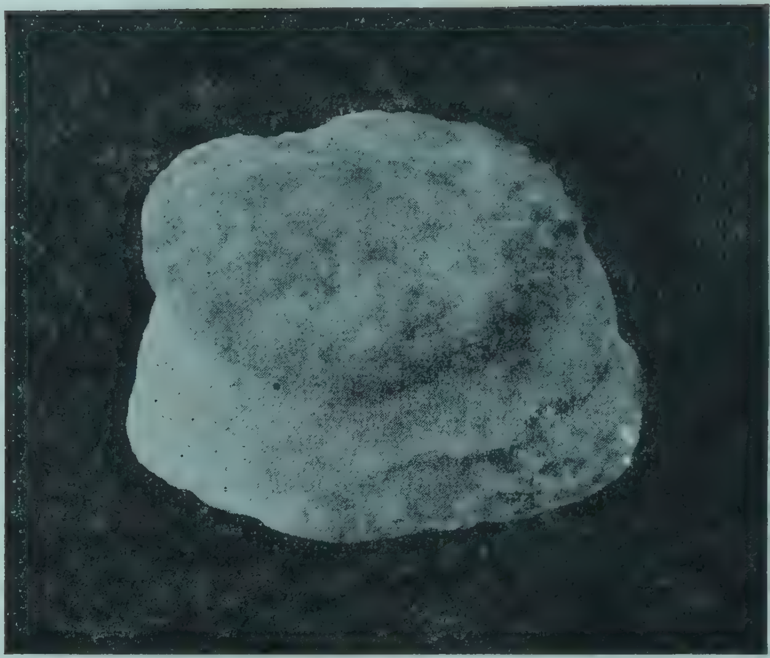


FIG. 40.—Biscuit made on first trial by an inexperienced person. The ingredients were well stirred together and the dough kneaded for a few seconds.

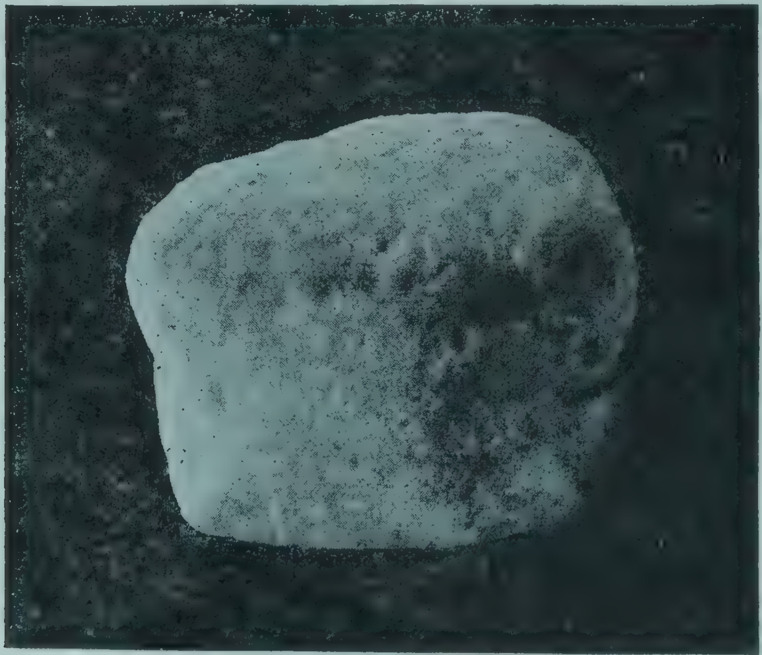


FIG. 41.—Biscuit in which the ingredients were well stirred together and the dough kneaded for a few seconds. Made by an experienced person. Note the symmetrical shape and the freedom from spots.

shapeless forms. Their tops are also fairly smooth and covered with a tender, golden-brown crust. These characteristics, especially that of regular shape, are well shown by the biscuit pictured in Figure 41.[1]

The inside of good biscuits is a creamy white, perfectly free from brown or yellow spots, and contains many small, evenly distributed holes. It appears light and fluffy rather than compact and soggy. Moreover, it is flaky, that is, it has the characteristic of peeling off into long, thin sheets when a bit of it is grasped and pulled upward by the fingertips. This flakiness, which is always accompanied by extreme lightness, is one of the most desirable qualities of biscuits. These interior characteristics, unfortunately, do not show in a photograph; hence the foregoing description of them will have to suffice.

PROPORTION OF INGREDIENTS

The first difficulty encountered in making such biscuits as have just been described is to get just that proportion of liquid and flour which will give a soft, easily handled dough. Unfortunately, no one definite amount of liquid can be given to fit all circumstances, for the proportion varies with the absorptive power of the flour and with the thoroughness with which the liquid and flour are combined. It also varies with the kind of liquid, for obviously one can use a larger proportion of milk, which is but 87 per cent water, than of water itself. This explains why in our biscuit recipe (p. 146) we tell what kind of liquid we use and why we limit the flour to the brands with which we have had experience (p. 56). With other flours some adjustment in the proportion of liquid may have to be made. If the biscuits are too soft to handle, the milk can be slightly decreased; or if too stiff, slightly increased. After two or three trials the right proportion will be found—a proportion which can be counted on to hold good for the brand of flour tested.

MANIPULATION OF INGREDIENTS

The difficulty in handling the ingredients comes in being able to do just that amount of stirring and kneading required to

[1] Biscuit made by Gladys Vail.

combine thoroughly the liquid with the dry ingredients without overdoing the process and making the biscuits heavy by loss of carbon dioxide. It is probable, however, that few people err in overmixing; the usual thing is to undermix.

The method which we have found to be most effective is given in detail, with full explanations for each step of the process, in the pages that follow, and also in a more or less abbreviated form in the biscuit recipe (p. 146). Though the whole procedure may seem somewhat complicated to the casual reader, we have found that it can be interpreted successfully by careful students. The biscuit shown in Figure 40 is typical of those made by a number of inexperienced persons in this laboratory, all of whom were provided with weighed materials and directions for working which they were allowed to interpret for themselves. In all cases fair biscuits were obtained at the first trial, and excellent ones, as good as those shown in Figure 41, at the second or third trial.

DIRECTIONS FOR COMBINING THE LIQUID WITH THE DRY INGREDIENTS

We begin by making a well in the center of the dry ingredients, after which we add all the liquid at once and then start stirring immediately. Until the flour is wetted, we have to be a little careful about our movements; but as soon as this is accomplished, we stir rapidly and vigorously until the mixture thickens to the point where further mixing with the spoon is almost impossible. As we work, the stirring takes about 20 seconds for the recipe, given on page 146, which calls for 2 cupfuls of flour. We begin to count the time the instant the wet ingredients are turned into the dry ones. If the recipe is doubled, the time of stirring must be increased—for our speed, to about 30 seconds. For the smaller recipe, we use a bowl with a capacity of 2 quarts; for the larger one, a 3-quart bowl.

Immediately after the mixture thickens, we turn it onto a lightly floured board, roll it around the board until it is covered with a film of flour, and start to knead or to roll and fold it. By the way it handles, we can tell whether or not we are going to have good biscuits. It should be extremely light and soft, but

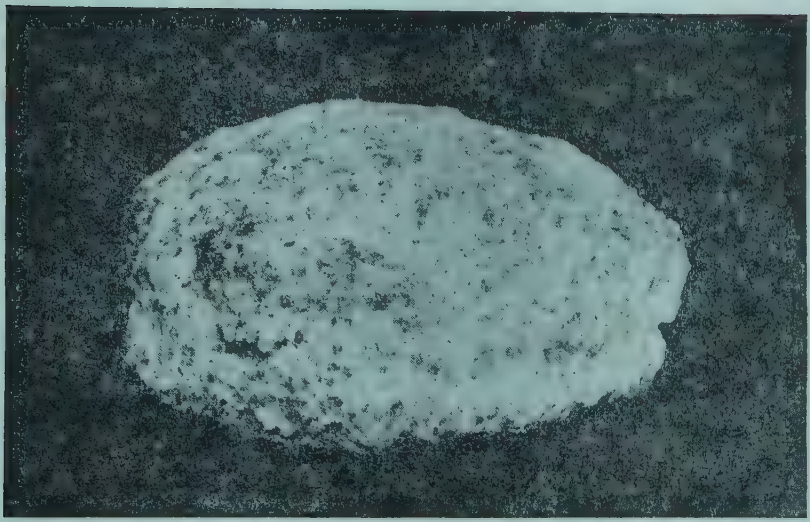


Fig. 42.—Biscuit in which the ingredients were stirred until barely combined and not kneaded at all. Note the small volume and mottled effect.

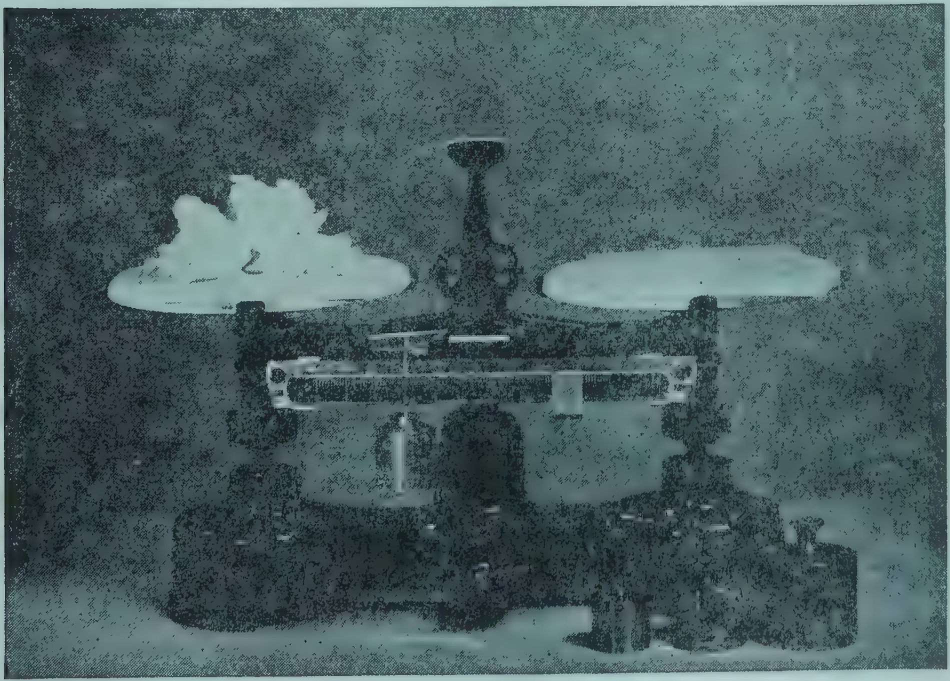


Fig. 43.—Weighing fat. It is more accurate and less trouble to weigh fat than to measure it.

not sticky. A dough which sticks to everything it touches is bound to make poor biscuits, and the more we work with it the worse it becomes. On the other hand, a solid hard dough will make poor biscuits; and, once made, nothing can be done to improve it. For the 2-cup recipe, our best results are obtained by kneading continuously for about 20 seconds—about 30 seconds for one calling for 4 cups of flour—or by rolling and folding twice.

WHAT IS MEANT BY A "LIGHTLY FLOURED BOARD"

A lightly floured board is one covered by a very thin layer of flour, so thin that the board may be seen easily through it or a clean, dry hand when laid upon it will pick up all the flour from the spot it touches. No more than 1 tablespoon of flour is necessary for flouring the board for both kneading and rolling the quantity of dough yielded by the recipe that follows.

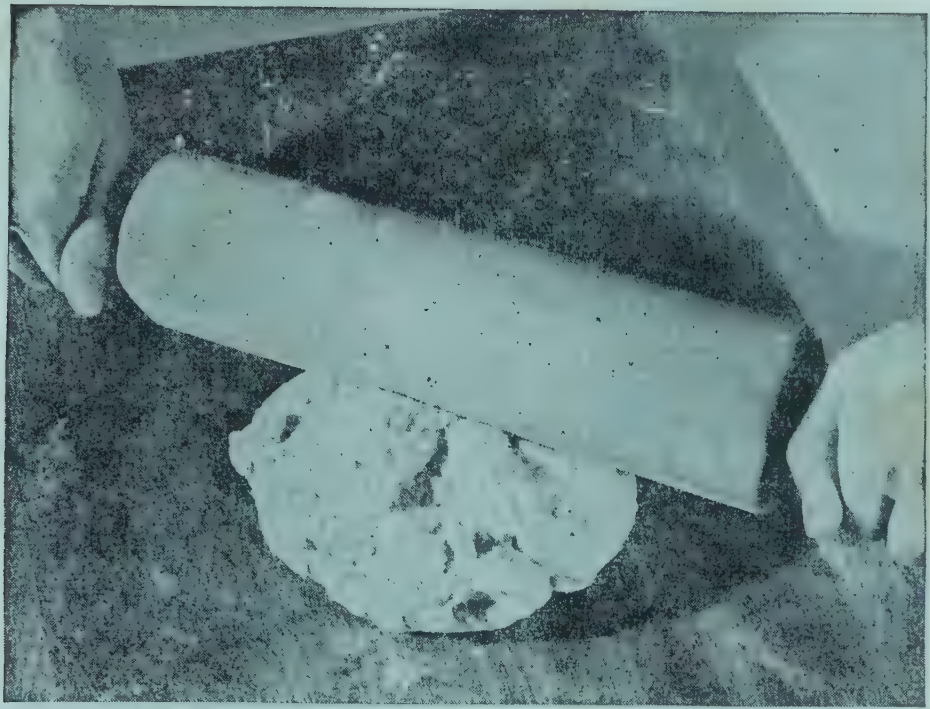
PURPOSE OF KNEADING AND OF ROLLING AND FOLDING

Either kneading or rolling and folding is required to effect a more thorough combination of the ingredients than can be accomplished by stirring only. With the proportions used in our biscuit recipe the mixture soon becomes too stiff to stir and, if some other process is not resorted to, the ingredients are not sufficiently well combined to give flaky biscuits. If more liquid is added so that more stirring can be done, the dough will not stiffen to the point where it can be handled. Besides, in such a soft dough much of the carbon dioxide will be lost during the stirring process and the finished product will be soggy rather than light.

METHOD OF KNEADING AND OF ROLLING AND FOLDING

In kneading, the ball of dough is flattened slightly with the palm of the hand, then reshaped into a ball and guided to a different place on the board. These three movements are continued throughout the required period.

Easier for the beginner than kneading and just as effective in making the biscuits flaky is the rolling and folding process shown in Figures 44–47. As can be seen, the dough is rolled into a sheet, then folded and re-rolled. This process is repeated a sec-



FIGS. 44 (*above*) and 45.—Initial steps in preparing biscuits by the roll and fold method. (For the final steps see Figs. 46–47.) After the milk has been added and the mixture stirred until it has thickened, the dough is turned onto a thinly floured board (Fig. 44) and rolled lightly into a sheet about a half-inch thick (Fig. 45).

FIGS. 46 (*above*) and 47.—Final steps in preparing biscuits by the roll and fold method. (For initial steps see Figs. 44–45.) The sheet of dough is folded to make a double layer (Fig. 46), then rolled and folded again. It is then rolled to the desired thickness (one-third to one-half the height preferred in the final product), and the biscuits are cut out with a lightly floured cutter (Fig. 47).

ond time in exactly the same way as the first, save that, in the final rolling, care is taken to have the sheet of dough one-half to one-third the thickness required in the biscuits when baked.

Whichever method is followed, the dough should be handled lightly so that it has no tendency to stick to the board even though only a dusting of flour is used.

EFFECTS OF OVERMIXING AND UNDERMIXING

Although one occasionally sees biscuits made soggy by overmixing, we were not able to make any such by a continuous process from the proportions of flour and liquid given, unless we stirred and kneaded for a period exceeding $2\frac{1}{2}$ minutes. We assume, then, that overmixed biscuits are made by very slow workers or by those who have been interrupted during the mixing process or, perhaps, by those who have used too much liquid. In the latter event, one is almost certain to overstir in working flour in so as to make it possible to handle the dough.

The usual trouble with biscuits is that they are undermixed. The effect of this is shown in the biscuit pictured in Figure 42. This one was made from the same ingredients in the same proportions as the biscuit of Figure 41. The only difference between the two was that in the one shown in Figure 42 no stirring was done in excess of that required barely to combine the ingredients, and no kneading at all; while that in Figure 41, as already stated, was made by stirring the dough until it thickened and then kneading it for a few seconds. As may be noted, the one handled as little as possible was rough, solid, unattractive, and only about one-half the height of the kneaded one, although both were rolled to the same thickness. Furthermore, the interior was coarse and had no appearance of flakiness, and the crust had many dark spots. Such spots have been shown by Newton and Willard[2] to be brought about by the acid portion of the baking powder dextrinizing or even carbonizing portions of the carbohydrates, particularly the starch, of incompletely combined doughs. Apparently, in the quick mixing to which these biscuits were subjected, not all the acid portion of the baking powder

[2] "The Occurrence of Dark Specks in Baking Powder Products," *Canadian Chemistry and Metallurgy*, XVIII (1934), 138.

had had a chance to react with the soda and, as a result, was free to act on the starch and thus produce the dark spots.

CUTTING THE DOUGH

When the dough is rolled for cutting, the sheet should be about half the thickness required in the baked biscuit if a tartrate or hydrated phosphate baking powder is used, one third if a S.A.S.–phosphate or anhydrous phosphate powder is used.

In order to have biscuits that are symmetrical in shape, the beginner will do well to flour the cutter after each cutting. This may be done without waste of time by dipping the cutter into a bowl of flour placed near by and lightly tapping it against the edge of the bowl to dislodge the extra flour. Another aid to symmetry is to use a spatula, rather than the fingers, in transferring the biscuits from the board to the baking sheet.

Once on the baking sheet, where they will not have to be handled further, biscuits may stand without deterioration for at least 15 minutes, preferably in a refrigerator.[3] While standing, they should be covered with a clean, damp cloth to prevent the crust from drying.

BAKING

Biscuits should be baked in a very hot oven, that is, at a temperature around 425° F., for a lower temperature dries them out before they are baked.

DIRECTIONS FOR THE PREPARATION OF BAKING-POWDER BISCUITS AND STRAWBERRY SHORTCAKE

BAKING-POWDER BISCUITS

Yield

Twenty biscuits, each 2 inches in diameter and about $1\frac{1}{4}$ inches high.

Utensils

A 2-quart, heavy mixing bowl, similar in shape to the one shown in Figure 25, page 59.

[3] Eleanor R. Maclay, "Effect of Delayed Baking upon Biscuits," *Journal of Home Economics*, XVIII (1926), 157.

One baking sheet with about 140 square inches of surface. The one used in this laboratory is 10 inches by 14 inches.

Approximate preparation time after a few trials

Ten minutes, exclusive of the baking period of about 12 minutes.

Before rolling and cutting, biscuit dough may stand without injury for several hours if wrapped in waxed paper or covered with a damp cloth and placed in the refrigerator.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family......	226	2 cups
or		
Soft-wheat family *or* cake	264	$2\frac{3}{4}$ cups
Salt....................	.....	1 teaspoon
Baking powder		
Tartrate...............	14.5	4 teaspoons
or		
Hydrated phosphate.....	16.0	4 teaspoons
or		
Anhydrous phosphate....	10.8	3 teaspoons
or		
S.A.S.-phosphate........	11.0	3 teaspoons
Fat (cold)...............	68	$\frac{1}{3}$ cup
Milk.....................	174	168 cubic centimeters ($\frac{2}{3}$ cup plus 2 teaspoons)

Order of work: Detailed form

1. Assemble the utensils and ingredients needed in the preparation of the biscuits. The baking sheet need *not* be oiled. Flour the board and rolling pin lightly (see p. 142).
2. (*a*) Weigh or measure the flour and baking powder. Measure the salt. Mix the three; then sift them into the mixing bowl.

b) Weigh or measure the fat; then turn it into the mixture of flour, baking powder, and salt.

c) Weigh or measure the milk.

3. Light the oven; turn it to 425° F.
4. Combine the ingredients as follows:

a) Combine the sifted dry ingredients and the fat with a pastry blender or with the fingers. If the latter method is used, place the fingers in the flour and roll one piece of fat after another along the tips with the thumb, using just barely enough force to break the fat into small pieces. This should be done lightly and quickly; if the fat is held too long or if the pressure exerted by the thumb is too great, the fat will melt. Whichever method is used, continue just long enough to divide the fat into pieces about the size of large peas.

b) Turn the milk all at once into the fat-flour mixture and stir vigorously until it thickens (for about 20 seconds).

c) Turn the dough onto the lightly floured board and, without delay, knead it for about 20 seconds (for method see p. 142), or roll and fold it (for method see p. 142 and Figs. 44–47). At the end of either process, roll the dough to the desired thickness (see p. 146). In doing so, use as little pressure on the rolling pin as possible.

5. Cut the dough with a floured biscuit-cutter.
6. If biscuits with crusty sides are desired, place them a half-inch or more apart on the baking sheet; otherwise place them so that they touch one another. In order to keep the shape symmetrical, use a spatula with a wide blade in transferring the biscuits from the board to the baking sheet.
7. Bake at 425° F. for about 12 minutes, or until the crust is an even brown and the inside is light, flaky, and dry.

Order of work: Abbreviated form

If the person who is to make the biscuits chooses to use a hard-wheat-family flour, and a tartrate baking powder, to weigh the fat and flour, and to measure the milk in a graduated cylinder, a résumé of the recipe is somewhat as follows:

1. Weigh or measure the ingredients:

Flour	226 grams
Salt	1 teaspoon
Baking powder	4 teaspoons
Fat (cold)	68 grams
Milk	168 cubic centimeters

2. Sift salt and baking powder with the flour; work the fat into the dry ingredients.
3. Add the milk, all at one time, to the fat-flour mixture; stir vigorously until the mixture thickens (about 20 seconds).
4. Knead about 20 seconds, or roll and fold.
5. Roll to the desired thickness.
6. Cut, transfer to baking sheet, and bake at 425° F. for about 12 minutes.

STRAWBERRY SHORTCAKE

Yield

Two individual shortcakes, each $2\frac{3}{4}$ inches in diameter, or one shortcake, $5\frac{1}{2}$ inches in diameter.

Utensils

A 2-quart, heavy mixing bowl, similar in shape to the one shown in Figure 25, page 59.

One baking sheet with about 70 squares inches of surface.

A biscuit-cutter about $2\frac{3}{4}$ inches in diameter.

Approximate preparation time after a few trials

Twelve minutes, exclusive of baking and placing the berries on the crust.

Proportion of ingredients

a) For the filling:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Strawberries	....	$\frac{3}{4}$ to 1 pint
Sugar	50 to 100	$\frac{1}{4}$ to $\frac{1}{2}$ cup

b) For the crust:

Flour		
Hard-wheat family	85	$\frac{3}{4}$ cup
or		
Soft-wheat family *or* cake	96	1 cup
Salt	....	$\frac{1}{4}$ teaspoon
Sugar	....	1 teaspoon
Baking powder		
Tartrate	5.5	$1\frac{1}{2}$ teaspoons
or		
Hydrated phosphate	6.0	$1\frac{1}{2}$ teaspoons
or		
Anhydrous phosphate	3.5	1 teaspoon
or		
S.A.S.–phosphate	3.5	1 teaspoon
Solid fat	32	$2\frac{1}{2}$ tablespoons
Milk	61	59 cubic centimeters ($\frac{1}{4}$ cup)

Order of work

1. Prepare the filling as follows:

   Wash and stem the berries. Set aside about one-half cup of the nicest ones. Cut the rest into halves or quarters, add the sugar; crush; and allow to stand until the crust is baked.

2. Prepare the crust[4] as follows:

   a) Sift salt, sugar, and baking powder with the flour; combine the fat with the dry ingredients.

[4] The directions for preparing shortcake crust are essentially the same as those for preparing biscuit, and therefore only an abbreviated form of these directions is given here.

b) Add the milk, all at one time, to the fat-flour mixture; stir vigorously until the mixture thickens (about 20 seconds).

c) Knead about 20 seconds, or roll and fold.

d) For individual shortcakes, roll the dough into a sheet about $\frac{3}{8}$ inch thick and cut two disks with a large biscuit-cutter. Place on a baking sheet and spread with a thin layer of melted butter. Gather together the remaining dough, roll and cut as before, and place on top of the others.

For a single shortcake, divide the dough into halves and roll each half into a sheet about $5\frac{1}{2}$ inches in diameter. Place one on top of the other with a layer of melted butter between.

A little time may be saved in preparation by rolling the dough into a single layer twice as thick as suggested, and splitting it with a fork after baking.

e) Bake for about 12 minutes in an oven at 425° F. Plan to have the dough baked just about the time it is to be combined with the fruit.

3. Prepare the shortcakes for serving as follows:

Separate the two layers; put each lower crust on a dessert plate; spread it with softened butter, and cover it with a layer of crushed strawberries. Place the upper crust, inner side up, over the lower one, butter, cover with a layer of the crushed strawberries, and then garnish with a few of the whole strawberries reserved for this purpose. Serve at once.

OTHER SHORTCAKES

Other fruits may be substituted for the strawberries. Two of these which may well be used in the winter (out of the fresh-berry season) are cooked dried apricots ($1\frac{1}{2}$ cups of cooked fruit prepared as suggested on page 186) and canned red raspberries (berries and part of the juice from a 1-pound, 3-ounce can).

CHAPTER VII

PIES

PLAIN PASTRY (PIECRUST)

CHARACTERISTICS OF GOOD PIECRUST

IN APPEARANCE, good piecrust is flaky, that is, its surface has a rough, blistered appearance rather than a smooth, firm one. Moreover, it is tender enough to cut easily with a fork, but not so tender that it crumbles. It is a golden-brown color around the edge, a somewhat lighter brown on the bottom; and, even though containing a filling, it is crisp on the bottom as well as along the edges.

MANIPULATION OF INGREDIENTS

The "secret" of making good, flaky pastry appears to be largely a matter of not overmixing the ingredients. If once the fat, flour, and liquid are all divided into tiny particles and these intimately mixed with one another, they tend to stay that way and give a smooth, solid, tough crust which is impervious to heat and browns unevenly, if at all.

Care in mixing the ingredients should begin with adding the fat to the flour. With the large proportion of fat used, it is easy enough for the inexperienced person, especially one who uses her fingers, to keep on working the ever warming fat into the flour until the grains of the latter become so coated with grease that they will not take up enough water to make the pastry flaky. What we really want are particles of *fat coated with flour*, and that is what we have if we do not overdo the combining process. There is little danger of doing this, however, if one starts with cold fat, works quickly, and uses a pastry blender or knives rather than the fingers in mixing the fat with the flour.

The most important point, however, is to add the water in such a way as to distribute it evenly among all the little fat-flour particles, giving each just enough to dampen it to the point where it will cling to its neighbor but not enough to make it sticky. To do this, we sprinkle a small portion of the water over the surface of the fat-flour mixture, then immediately bring this dampened part in contact with as much undampened as possible by running a fork along the bottom of the bowl and lifting it with a tossing motion through the mixture. Such a motion exerts no appreciable pressure but serves to make such particles as are dampened stick together and roll up into little lumps. Each time we add water we try to put it on an undampened spot. At first we sprinkle it between lumps; at last we push the lumps to one side or remove them from the bowl and sprinkle the unwetted portion thus exposed to view.

To determine when we have added enough water, we press the dampened particles gently to see if they tend to stick together. If they do not, we add a bit more water. If they do, we divide them into the required number of portions, each of which we form into a disk by pressing the particles firmly together without mixing or kneading.

The process just described is probably the one which, consciously or unconsciously, the rank and file of cooks follow in making pastry, and one that gives them no trouble whatever. The beginner, however, tends to add either too much or too little water, with the result that the dough is sticky, on the one hand; crumbly, on the other; and in either case hard to handle. One way to lessen this difficulty is to use a modification proposed by Mrs. Clara G. Snyder, of the Wheat Flour Institute, which helps in adjusting the liquid and tends to make the pastry flaky even if somewhat overmixed. In this, a small portion, about 2 tablespoons, of the blended fat-flour mixture is removed to a separate bowl and set aside until the water has been added to the main portion of the mixture and the dough gathered into a ball. This ball is then rolled into an oval sheet about 6 by 10 inches and sprinkled with the remaining fat-flour mixture, after which

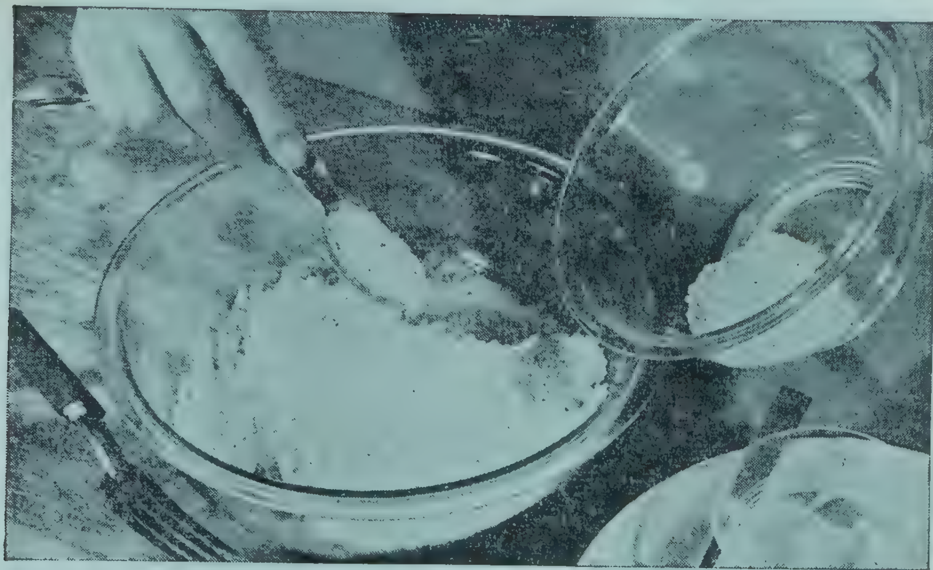
the sheet is treated like a jelly-roll cake, by rolling it crosswise to make a 6-inch cylinder (see Figs. 48–57). This cylinder is then cut into two 3-inch pieces, one of which is placed on top of the other, lengthwise, and the whole mass shaped gently into a disk which can be rolled into a circular sheet.

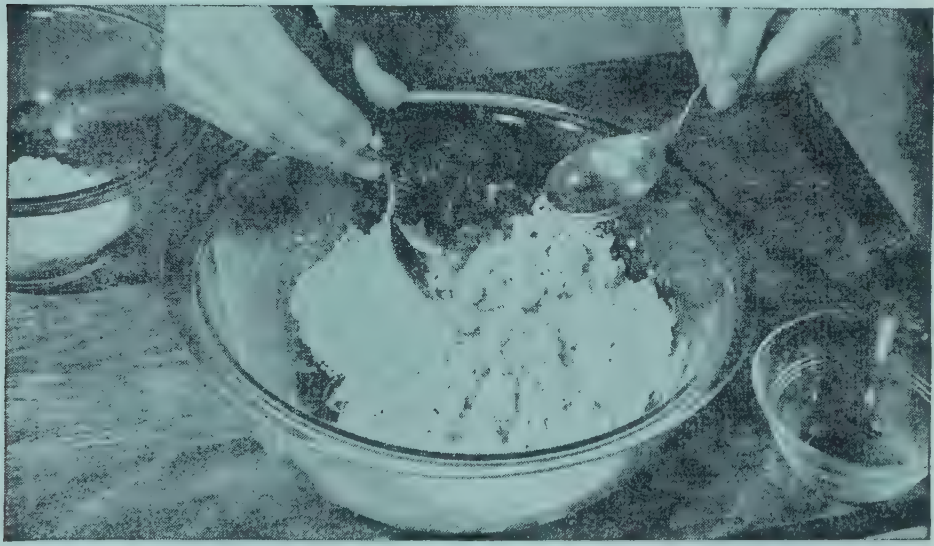
If the room is cool and we work quickly, we take no special precaution regarding the temperature of the ingredients other than to keep the fat in the refrigerator until we are ready to use it and to have the water cold enough for drinking. If, however, the room is hot and damp, we set the fat-flour mixture in the refrigerator to chill before adding the water, and, if necessary, chill the dough before rolling it. In other words, we keep the mixture so cool that the fat shows no tendency to melt.

For a deep pie tin such as we use (perpendicular height, $1\frac{1}{4}$ inches), we find that the diameter of the bottom crust should be about $2\frac{1}{2}$ inches greater than that of the outside diameter of the top of the pan in order to allow enough dough to fit down into the pan without leaving large air spaces between the two. Such air would, of course, expand during baking, pull the crust back from the edge of the pan, and give the pie a shrunken appearance.

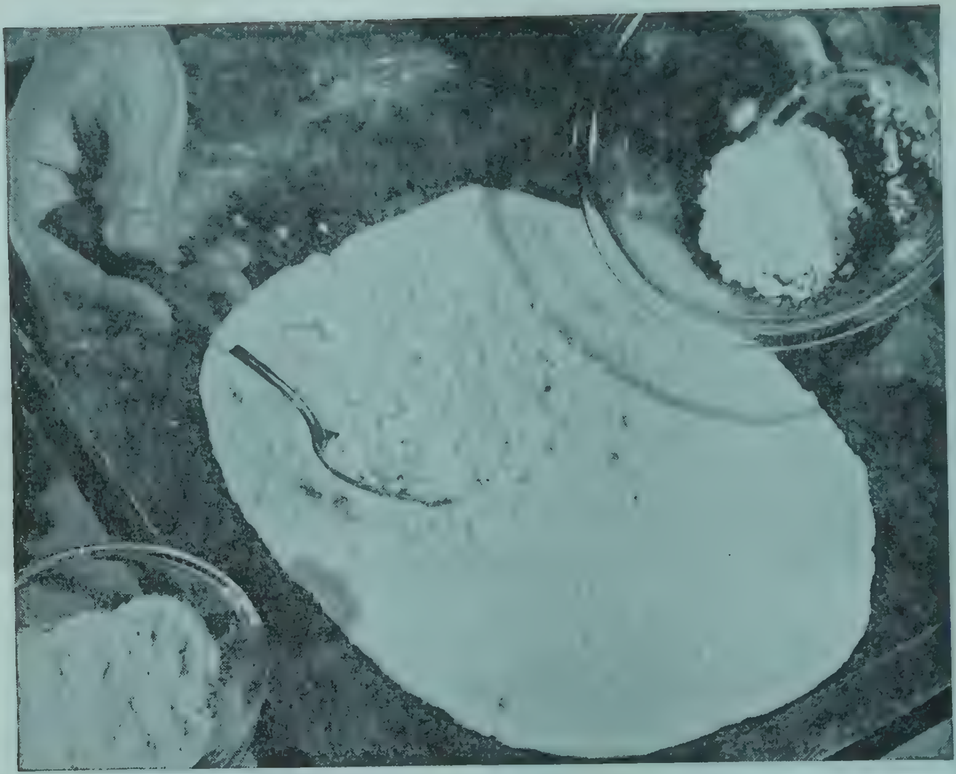
The upper crust need be but slightly larger than the pie it is to cover—just enough to allow for the rounding-up of the filling. Before putting it in place, a few holes should be made to allow for the escape of steam from the filling during cooking. These holes are usually arranged in a design to add to the attractiveness of the pie. In making this design, one should avoid cutting long slashes through the crust, for these tend to tear in transferring the pastry from the board to the pan and to spread during baking, thereby ruining the appearance of the pie.

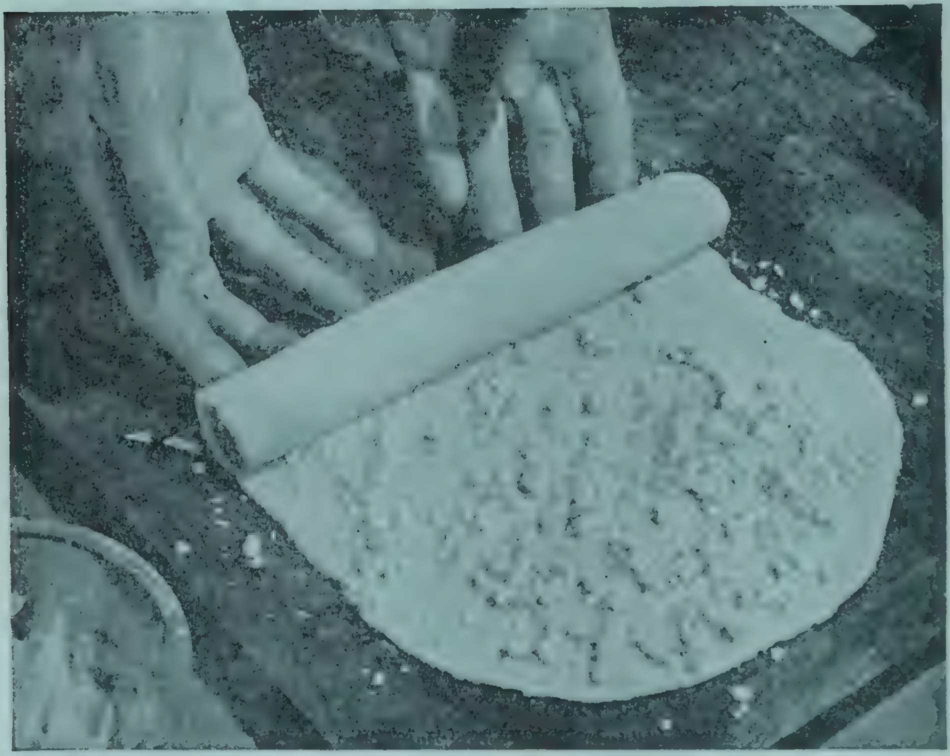
In order to make the upper and lower crusts of a two-crust pie stick together and thus prevent juice from running out, it is customary to dampen the edge of the lower crust just before putting the upper one in place and to cement the two together by pressing firmly all around the edge with the tines of a fork, held points in, or with the fingers. Not until this is done should





FIGS. 48 (*top*), 49, and 50.—Initial steps in preparing pastry by a modified puff-paste method (successive steps are shown in Figs. 51–57). After the flour and fat have been blended together, a small amount (about 1 tablespoon per crust) is removed to another bowl (Fig. 48). Water is then sprinkled over the surface of the remaining portion, and, at the same time, dry material is brought to the surface with a fork (Fig. 49). Sufficient water is added to dampen all the blended flour and fat; then a large enough quantity of dampened material for one crust is pressed into a ball, which is rolled in the dry flour-fat mixture if the surface feels sticky (Fig. 50).





Figs. 51 (*above*) and 52.—Steps in preparing pastry by a modified puff-paste method (continued from Figs. 48–50). The rest of the dry flour-fat mixture is sprinkled over the surface of a crust obtained by rolling the ball shown in Figure 50 into a sheet 7–8 inches long and about 6 inches wide (Fig. 51). The crust with its covering of blended flour and fat is then rolled up like a jelly roll (Fig. 52).

FIGS. 53 (*above*) and 54.—Steps in preparing pastry by a modified puff-paste method (continued from Figs. 48–52). The roll of piecrust (see Fig. 52) is cut into two pieces of approximately the same length (Fig. 53). One half of the roll is placed on top of the other, the thin portion of one resting upon the thick portion of the other (Fig. 54).

FIG. 55.—The rolls of piecrust, after being stacked on top of each other (see Fig. 54), are firmly pressed together.

FIG. 56.—The rolls of piecrust, after being firmly pressed together (see Fig. 55), are shaped into a disk.

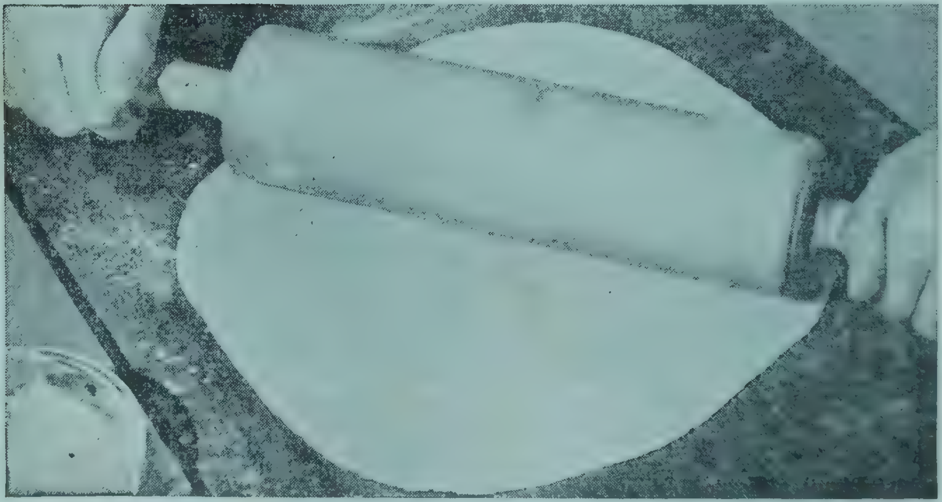


FIG. 57.—The final step in the preparation of pastry by the modified puff-paste method is rolling into a round sheet about $\frac{1}{8}$ inch thick. (For other steps see Figs. 48–56.)

the surplus crust be trimmed off. To do this without cutting off more crust than is absolutely necessary for an even edge, one should hold the pie on the palm of the hand and the knife underneath with its cutting-edge just touching the tin and making an angle of about 45° with it on the under side (Fig. 59).

BAKING

Pie shells should be baked in a very hot oven (450° F.) until they feel firm and dry and until the edge of the crust is an even golden brown. They have a great tendency to bulge up from the tin, even if they seemingly fit it like the paper on the wall. The usual method of overcoming this tendency is to make a number of small holes along the bottom and sides of the crust with a fork before putting it in to bake, and to prick any bubble which chances to form during baking before the dough sets. An easier way is to hold the crust down to the tin by placing inside it another tin of the same size which is allowed to stay there until the crust has hardened (Fig. 58).

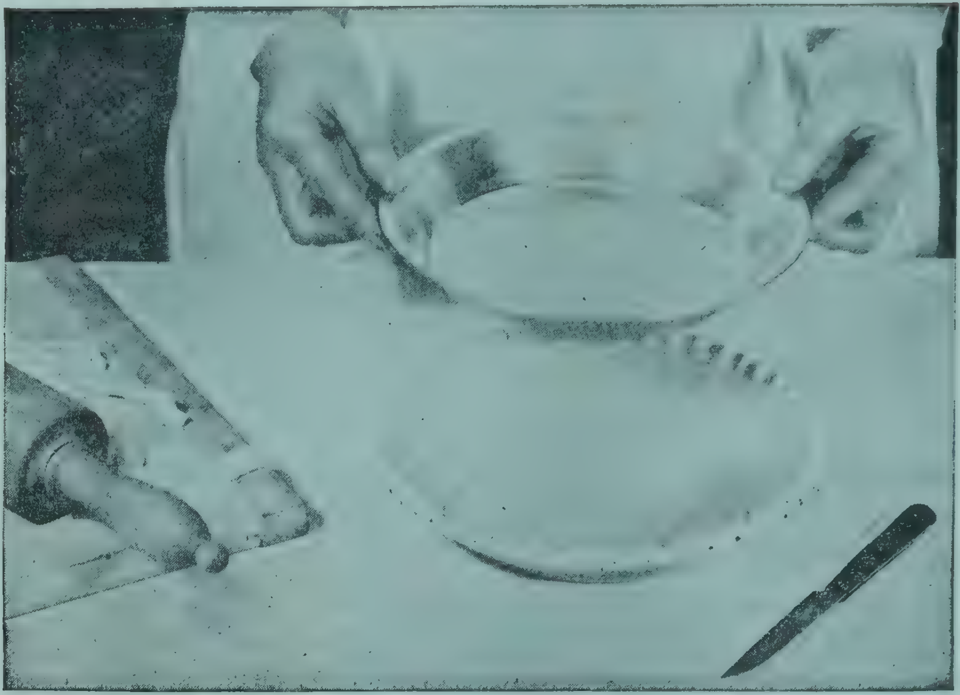
The temperature at which filled pies are baked depends on the filling and will be given under the individual pie recipes. In general, however, such pies are placed in a hot oven for the first few minutes in order to start the baking of the lower crust before the filling has had time to soak into it; then during the rest of the period they are baked at a lower temperature suited to the filling. Both crusts should be an even golden brown when the baking-period is over.

PIE FILLINGS

Pie fillings, strangely enough, give the beginner far less trouble than the crust itself. For this reason the discussion on fillings is limited to a few words, whereas much space has been devoted to the hows and whys of preparing the crust.

CUSTARD PIE

A good custard pie filling resembles a good fruit jelly in that it is tender and quivery, yet keeps its angles when cut and does not show syneresis or "weeping" on standing. Furthermore, it



Courtesy of the Evaporated Milk Association

Fig. 58.—Pie shell ready to be baked. The crust is held in place during baking by a second piepan.

Fig. 59.—By holding the pie and the knife in this position, the surplus crust can be trimmed off without cutting away so much of it that the tin is exposed to view when the pie is baked.

has a delicate golden-brown surface entirely free from the heavy, dark-brown layer sometimes observed on this type of pie.

The chief difficulty encountered in making custard pie is in the baking. If the temperature of the oven is high, the filling will tend to weep; whereas if it is low, the filling will soak into the crust. One method of overcoming this difficulty is to use a combination of baking temperatures—a hot one for just long enough to start baking the crust but not long enough to overheat the filling, then a low one to finish baking both the crust and the filling. In order to reduce the temperature quickly, we lower the regulator and open the oven door and leave it open for about 10 minutes or until cool enough that the filling will bake without bubbling.

PUMPKIN PIE

Pumpkin pie filling resembles custard in its general characteristics. It has more body, however, and therefore lacks the delicate jelly-like consistency of the latter.

The chief requirement in the preparation of pumpkin filling is that the pumpkin be cooked sufficiently dry that liquid has no tendency to seep from it as it stands. Canned pumpkin often fulfils this condition and is more convenient to use than fresh. The latter requires a long preliminary preparation. It must be pared and steamed or boiled in the same manner as squash (see p. 30), drained, mashed, reheated over a *very low* flame with constant stirring until no more water separates from it, and finally cooled somewhat, before it is ready to use in the filling.

With good pumpkin to draw from, this pie is more easily baked than custard, partly because the filling is more stable to the high initial temperature required for cooking the crust, and partly because the pumpkin mixture, being somewhat thicker than the custard, has less tendency to soak into the crust.

CREAM PIES

The filling for cream pies, including chocolate, lemon, cocoanut, and those containing such fruit as pineapple and bananas, should be stiff enough that it will not run over the plate when cut, but not so stiff as to be pasty, as indicated by its tendency

to hold its cut edges rigidly. Such filling, moreover, should be perfectly smooth, with all the ingredients so well blended together that there is not the faintest suspicion of lumpiness. Finally, there should be no flavor of raw starch in the cooked filling.

In order to obtain such a filling, one must be careful to use just the proportion of flour or starch called for in the directions; to cook the mixture carefully, preferably in a double boiler; and during cooking to stir it constantly until it thickens.

DIRECTIONS FOR THE PREPARATION OF PLAIN PASTRY (PIECRUST)

Before attempting to use this recipe, read the preceding discussion on pies and the section on weighing and measuring (p. 35).

Yield

One crust for a piepan of 700 cubic-centimeter (about 3-cup) capacity. The one used in this laboratory is $7\frac{1}{2}$ inches in diameter (at the top) and $1\frac{1}{4}$ inches deep. This crust is enough for a one-crust pie which cuts into 6 pieces, each about $3\frac{3}{4}$ inches across the outer edge.

Approximate preparation time after a few trials

Fifteen minutes, exclusive of the baking period.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	85	$\frac{3}{4}$ cup
or		
Soft-wheat family *or* cake	96	1 cup
Salt	..	$\frac{1}{2}$ teaspoon
Solid fat (cold)	38	3 tablespoons
Water (cold)	..	28 to 33 cubic centimeters (about 2 tablespoons)

Order of work

1. Assemble the ingredients and utensils needed in the preparation of the pastry. Dust a very thin layer of flour over the rolling-pin and board or pastry cloth. No more than a tablespoon of flour should be necessary during the entire rolling process.
2. Note that the proportions are given for *one* crust. If *two* crusts are desired, take twice the amount specified for each ingredient.
3. (*a*) Weigh or measure the flour. Measure the salt. Turn them into the mixing bowl.
   b) Weigh or measure the fat, cut it into a number of pieces, and put it into the flour.
   c) Measure the water.
4. Combine the fat with the flour and salt either by cutting the two together with a pastry blender or knives or by rubbing them together with the fingers, until the particles are about the size of navy beans.

   To use a pastry blender, simply cut through the ingredients until the particles have become the desired size.

   To use knives, hold one in each hand and cut crosswise through the mixture until it is separated into small particles.

   To use the fingers, place them in the flour and roll one piece of fat after another along the tips with the thumb, using just barely enough force to break the fat into smaller pieces. This manipulation should be done lightly and quickly; if the fat is held too long, or if the pressure exerted by the thumb is too great, the fat melts.
5. Dampen all of the flour-fat mixture, or remove 2 tablespoons of it to another bowl, and dampen the remainder. To dampen, sprinkle a scant teaspoon or so of water over the flour-fat mixture and immediately bring the material so dampened into contact with as much of the dry as possible by running the fork along the bottom of the bowl and bringing it up with a tossing motion through the mixture.

As the particles accumulate, push them to one side. Distribute the water evenly in this way until the whole mixture is uniformly dampened.

6. If only one crust is being prepared, press all the dampened particles firmly together either with the hands or with the back of a spoon.

   If two crusts are being prepared, divide the mixture into two equal portions and press the particles of each firmly together.

   Do not handle the dough any more than is necessary.

7. Shape and roll the dough as follows:

   a) If all the flour-fat mixture was dampened, lay the ball of dough on the floured board or pastry cloth; pat it until it becomes flat on top. If the edge begins to split, pinch the cracks together. Place the rolling-pin lightly on the center of the dough and roll toward the edge with successive short strokes in such directions as will keep the shape round. As soon as the dough begins to stick to the board (which is indicated by its failure to spread out as the rolling-pin passes over it), loosen gently along one edge with the side (*not the end*) of a spatula. Then turn the freed portion over the palm of the left hand and rest it there while the remainder of the crust is loosened and the board redusted with flour.

   Continue the rolling process until the crust is 9–10 inches in diameter. (It will then be about $\frac{1}{8}$ inch thick.)

   b) If part of the flour-fat mixture was set aside undampened, roll the ball of dough around in it, and then place the ball on a floured board or pastry cloth. With a lightly floured rolling-pin, roll it into a sheet approximately 6 by 10 inches. Loosen the sheet from the board, and spread the rest of the flour-fat mixture over it. Begin at one of the ends and roll the sheet up like a jelly roll (see Figs. 48–57). Cut the roll into halves, lay one half on top of the other, and shape into a disk. Place the rolling-pin lightly on the center of the dough

and roll toward the edge with successive short strokes in such directions as will keep the shape round. As soon as the dough begins to stick to the board (which is indicated by its failure to spread out as the rolling-pin passes over it), loosen it gently along one edge with the side (not the end) of a spatula. Then turn the freed portion over the palm of the left hand and rest it there while the remainder of the crust is loosened and the board or pastry cloth redusted with flour. Continue the rolling process until the crust is 9–10 inches in diameter. (It will then be about $\frac{1}{8}$ inch thick.)

8. Place the lower crust in the pan as follows:
   a) When the dough has been rolled to the desired size, loosen it from the board and transfer it to the pie tin. As an aid in transference, the crust, after it has been loosened, may be lightly folded together by bringing one half over the other (forming a semicircle), then folding again lengthwise (forming a quarter-circle).
   b) Place the pastry in a pie tin[1] (which need not be oiled) so that it covers the surface smoothly and loosely. Fit it carefully into the angle between the side and bottom of the tin, pressing it down into the crease with the fingers of one hand while the other hand holds the sheet away from the sides of the tin so that it will not be stretched or broken.
9. The treatment of the crust from now on depends upon the type of pie for which it is to be used. Therefore the directions for each type are given separately.
   a) For a one-crust pie in which the crust is to be baked alone:
   (1) Press the pastry firmly to the rim of the pan with either the fingers or the tines of a fork; then trim the edge even with the pan; *or* trim off the pastry about $\frac{1}{4}$ inch larger than the pan, roll the extra

[1] For a one-crust pie in which the shell is to be baked alone, the pastry may be fitted, if desired, over the outside of the inverted pie tin rather than over the inside.

dough onto the rim of the piepan, and pinch portions of it together with the finger and thumb into a fluting that stands above the edge of the pan (see Fig. 58).

(2) With a paring knife (or fork) make a number of small holes in the bottom and along the sides of the crust; *or* set lightly over the crust a pie tin of the same size as the one holding the crust (see Fig. 58). (In the latter case, do not pierce the pastry.)

(3) Place in an oven at 450° F. During the first 4 or 5 minutes of baking, watch the crust carefully if it is not covered by another pan. While still soft, prick more holes wherever it bulges away from the pan.

(4) Pie shells should be baked about 12 minutes, or until they are a golden brown around the edge and slightly brown on the bottom.

b) For a one-crust pie in which the crust and filling are to be baked together:

(1) Press the pastry firmly to the rim of the pan with either the fingers or the tines of a fork; then trim the edge even with the pan; *or* trim off the pastry about $\frac{1}{4}$ inch larger than the pan, roll the extra dough onto the rim of the pan, and pinch portions of it together with the finger and thumb into a fluting that stands above the edge of the pan (see Fig. 58).

(2) Add part of the filling. Place the pie on the oven rack, being careful to have the rack level. Add the rest of the filling. Bake at a temperature suitable for the filling. (See individual pie recipe for the temperature.)

c) For a two-crust pie:

(1) Roll the second portion of the dough in the same manner as the first into a sheet $\frac{1}{8}$ inch thick; loosen

it from the board; and cut small holes in the center. These holes are usually arranged in a design.

(2) Put the filling into the lower crust.

(3) Dampen the lower crust around the edge.

(4) Lay the upper crust lightly over the filling.

(5) With the tines of a fork, press the edges of the two crusts firmly together; then trim off the edges (see Fig. 59).

(6) Bake at a temperature suitable for the filling. (See individual pie recipe for the temperature.)

DIRECTIONS FOR THE PREPARATION OF PIES[2]

Yield for each recipe

One pie which will cut into 6 sectors, each $3\frac{3}{4}$ inches across the outer edge and $1\frac{1}{4}$ inches deep.

Baking pan for each recipe

Capacity: 700 cubic centimeters (about 3 cups).

Pan used in this laboratory: $7\frac{1}{2}$ inches in diameter (at the top) and $1\frac{1}{4}$ inches deep.

CUSTARD PIE

Approximate preparation time after a few trials

Twenty minutes, exclusive of the baking period of about 50 minutes.

Proportion of ingredients

a) For the filling:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Whole eggs	96	2 medium sized
or		
Egg yolks	72	4 medium sized
Sugar	100	$\frac{1}{2}$ cup
Milk	488	2 cups (474 cubic centimeters)

[2] *Careful* measurement of the ingredients used in *pie fillings* will give proportions sufficiently accurate for home cooking.

Proportion of ingredients —*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
or		
Coffee cream (18 per cent)	159	$\frac{2}{3}$ cup
and		
Milk	325	$1\frac{1}{3}$ cups (315 cubic centimeters)
Salt	...	$\frac{1}{4}$ teaspoon
Vanilla	...	$\frac{1}{2}$ teaspoon
Nutmeg	...	$\frac{1}{2}$ teaspoon
b) For the crust:		
Flour		
Hard-wheat family	85	$\frac{3}{4}$ cup
or		
Soft-wheat family *or* cake	96	1 cup
Salt	...	$\frac{1}{2}$ teaspoon
Solid fat (cold)	38	3 tablespoons
Water (cold)	...	28 to 33 cubic centimeters (about 2 tablespoons)

Order of work

1. Prepare the pie shell as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, press the dampened material firmly together, roll into a sheet 9–10 inches in diameter, and fit into a piepan; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 2 tablespoons to a separate bowl, dampen the remainder, press the dampened particles together, roll, spread

with the dry fat-flour mixture, roll up like a jelly cake, cut, press together, re-roll into a sheet, and fit into a piepan.

2. Light the oven and set the regulator at 425° F.
3. Prepare the filling as follows:
   a) Beat the whole eggs or egg yolks until they are well blended. Use a bowl large enough to allow the filling to be mixed without spattering (about 2 quarts).
   b) Weigh or measure the sugar. Add it slowly to the eggs while beating with a spoon or fork. Add the salt and vanilla.
   c) Weigh or measure the milk or the cream and milk. Stir about 4 tablespoons into the egg-sugar mixture. When the piecrust has been prepared and fitted into the pan, heat the rest of the milk or the cream and milk over a low flame to almost the boiling-point (stir frequently to prevent scorching), then pour slowly with constant stirring into the egg-sugar mixture.
4. Immediately pour three-fourths of the filling into the piecrust; sprinkle the nutmeg over the surface; set the pie on the oven rack; and then add the rest of the filling.
5. Bake at 425° F. for 10 minutes, then lower the regulator to 325° F., and open the oven door. Leave the door open for 10 minutes, then close the door and bake the pie until a knife, run into the center of the filling, comes out clean (about 30 minutes).
6. Remove the pie from the oven just as soon as the custard is baked, and set it on a cake rack to cool—3 to 4 hours will be required at ordinary room temperature.

PUMPKIN PIE

Approximate preparation time after a few trials

Twenty-five minutes, exclusive of the baking period of about 1 hour.

Proportion of ingredients

a) For the filling:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Eggs	96	2 medium sized
Cooked pumpkin	248	1 cup
Light-brown sugar	175	$\frac{7}{8}$ to 1 cup
Salt	...	$\frac{1}{2}$ teaspoon
Hot water	...	1 tablespoon
Ginger and cinnamon	...	$\frac{3}{4}$ teaspoon, each
Orange juice	...	2 tablespoons (juice of about $\frac{1}{3}$ orange)
Milk	183	$\frac{3}{4}$ cup (178 cubic centimeters)

b) For the crust:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	85	$\frac{3}{4}$ cup
or		
Soft-wheat family *or* cake	96	1 cup
Salt	...	$\frac{1}{2}$ teaspoon
Solid fat (cold)	38	3 tablespoons
Water (cold)	...	28 to 33 cubic centimeters (about 2 tablespoons)

Order of work

1. Prepare the filling as follows:
   a) Beat the eggs until foamy in a bowl large enough to allow the filling to be mixed without spattering (about 2 quarts).
   b) Weigh or measure the pumpkin, brown sugar (rolled or sifted if necessary to remove lumps), salt, and orange juice. Mix them with the eggs.
   c) Measure the spices and hot water. Mix them and then stir them into the egg-sugar-pumpkin mixture.

d) Weigh or measure the milk and mix it with the rest of the filling.

2. Prepare the pie shell as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, press the dampened material firmly together, roll into a sheet 9–10 inches in diameter, and fit into a piepan; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 2 tablespoons to a separate bowl, dampen the remainder, press the dampened particles together, roll, spread with the dry fat-flour mixture, roll up like a jelly cake, cut, press together, re-roll into a sheet, and fit into a piepan.
3. Pour about three-fourths of the filling into the unbaked shell; set the pie on the oven rack; add the rest of the filling.
4. Bake the pie at 425° F. for the first 20 minutes; then lower the regulator to 250° F. and continue the baking for about 40 minutes longer. When the pie is completely baked, the filling will be firm and will not stick to a knife blade. The edge of the crust will be a golden brown.
5. Three to 4 hours will be required for cooling at ordinary room temperature.

CHOCOLATE PIE

Approximate preparation time after a few trials

One-half hour, exclusive of the browning of the meringue.

Proportion of ingredients

a) For the crust:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family . . .	85	$\frac{3}{4}$ cup
or		
Soft-wheat family *or* cake	96	1 cup
Salt	. . .	$\frac{1}{2}$ teaspoon

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Solid fat	38	3 tablespoons
Water (cold)	...	28 to 33 cubic centimeters (about 2 tablespoons)
b) For the filling:		
Bitter chocolate	28	1 square
Sugar	134	$\frac{2}{3}$ cup
Flour		
Hard-wheat family	30	4 tablespoons
or		
Soft-wheat family *or* cake	35	6 tablespoons
Salt	...	$\frac{1}{4}$ teaspoon
Milk	366	$1\frac{1}{2}$ cups (355 cubic centimeters)
Egg yolks	36	2 medium sized
Butter	9	2 teaspoons
Vanilla	...	$\frac{1}{2}$ teaspoon

Order of work

1. Weigh or measure the chocolate, and start it to melt in a double boiler.
2. Prepare the pie shell as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, press the dampened material firmly together, and roll into a sheet 9–10 inches in diameter; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 2 tablespoons to a separate bowl, dampen the remainder, press the dampened particles together, roll, spread with the dry fat-

flour mixture, roll up like a jelly cake, cut, press together, and re-roll into a sheet 9–10 inches across.

b) Fit the sheet into a piepan, prick or cover with another piepan, and bake until brown (about 12 minutes) in an oven at 450° F. As soon as the crust is baked, lower the oven regulator to 300° F.

3. Prepare the filling as follows:

a) Weigh or measure the sugar, flour, and salt; mix and then stir them into the melted chocolate. Remove the top of the double boiler from the heat.

b) Weigh or measure the milk. Add just enough of it to the chocolate mixture to make a thick paste (about 2 tablespoons) and stir out any lumps. Be sure that the dry ingredients that cling around the edge of the pan are mixed with the rest.

c) Separate the egg whites from the yolks. Place the whites in a bowl in which they can be beaten conveniently, for they are to be used later in the preparation of the meringue. Turn the yolks into the chocolate-sugar-flour-milk mixture and beat with a spoon until well combined. Stir in the rest of the milk slowly. Add the butter.

d) Cook this mixture in the double boiler until it thickens (about 15 minutes) sufficiently that a spoonful when removed and turned back falls in ridges which do not disappear for about a minute. It will have to be stirred frequently to prevent lumping.

e) Remove from the fire; add the vanilla; beat until smooth, and then pour into the piecrust.

4. Prepare the meringue according to directions given below; spread it over the filling, and brown it in the oven at 300° F. (about 15 minutes).

5. Three to 4 hours will be required for cooling at ordinary room temperature.

MERINGUE

Approximate preparation time after a few trials

About 5 minutes, exclusive of the browning period.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Egg whites (left from the filling)	60	2 medium sized
Granulated sugar	25	2 tablespoons

Order of work

1. Beat the egg whites until they are foamy.
2. Weigh or measure the sugar. Add it to the whites and continue beating with the egg-beater until the mixture is stiff enough to hold its shape.
3. Immediately spread it over the pie filling, being careful to make it touch the crust around the edge of the pie.
4. Brown in an oven at 300° F. This will take about 15 minutes, if the piecrust has been baked just previously; otherwise, about 25 minutes.

LEMON CREAM PIE

Approximate preparation time after a few trials

One-half hour, exclusive of the browning of the meringue.

Proportion of ingredients

a) For the crust:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	85	$\frac{3}{4}$ cup
or		
Soft-wheat family *or* cake	96	1 cup
Salt	...	$\frac{1}{2}$ teaspoon

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Solid fat (cold)	38	3 tablespoons
Water (cold)	...	28 to 33 cubic centimeters (about 2 tablespoons)
b) For the filling:		
Eggs		
Whole	48	1 medium sized
Yolks	54	3 medium sized
White	30	1 medium sized
Sugar	150	$\frac{3}{4}$ cup
Salt	...	$\frac{1}{4}$ teaspoon
Flour		
Hard-wheat family *or*	24	$3\frac{1}{2}$ tablespoons
Soft-wheat family *or* cake	30	5 tablespoons
Lemon rind	...	1 teaspoon (rind of 1 lemon)
Lemon juice	...	$\frac{1}{3}$ cup (79 cubic centimeters)[3]
Milk	325	$1\frac{1}{3}$ cups (315 cubic centimeters)

Order of work

1. Prepare the pie shell as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, press the dampened material firmly together, and roll into a sheet 9–10 inches in diameter; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 2 tablespoons to a separate bowl, dampen the remainder, press the dampened particles together, roll, spread with the dry fat-flour mixture, roll up like a jelly cake, cut, press together, and re-roll into a sheet 9–10 inches in diameter.

[3] Juice from $2\frac{1}{2}$–3 lemons.

b) Fit the sheet into a piepan, prick, or cover with another piepan, and bake until brown (about 12 minutes) in an oven at 450° F. As soon as the crust is baked, lower the oven regulator to 300° F.

2. Prepare the filling as follows:
   a) Beat together the whole egg and the egg yolks until foamy; turn them into a double boiler.
   b) Weigh or measure the sugar, salt, and flour; mix and then stir them with the beaten eggs.
   c) Grate the lemon rind. Measure the lemon juice. Stir them into the egg-sugar-flour mixture.
   d) Weigh or measure the milk, and stir it, slowly at first, into the egg-sugar-flour-lemon-juice mixture. Be sure the ingredients that cling around the edge of the pan are mixed with the rest.
   e) Cook this mixture in the double boiler until it thickens (about 15 minutes).
   f) Beat the egg white until it is stiff. Immediately pour about a tablespoon of the hot mixture over the surface of the white and, with a spoon, beat until the two are well mixed. Combine 4 or 5 more tablespoons of the hot filling with the egg white in the same manner; then pour this egg-white mixture slowly into the hot filling, stirring the latter vigorously during the addition.

      Cook the filling for about 2 minutes, or until it is sufficiently thick that a spoonful when removed and turned back falls in ridges which do not flatten out for about a minute.
   g) Remove the filling from the fire; beat until smooth; then pour into the piecrust.
3. With the 2 egg whites left over from the filling, prepare a meringue according to the directions given on page 174. Spread this meringue over the filling; brown it in an oven at 300° F. (about 15 minutes).
4. Three to 4 hours will be required for cooling at ordinary room temperature.

COCOANUT CREAM OR BANANA CREAM PIE

Approximate preparation time after a few trials

About $\frac{1}{2}$ hour, exclusive of the browning of the meringue.

Proportion of ingredients

a) For the crust:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family . . .	85	$\frac{3}{4}$ cup
or		
Soft-wheat family *or* cake	96	1 cup
Salt	. . .	$\frac{1}{2}$ teaspoon
Solid fat (cold)	38	3 tablespoons
Water (cold)	. . .	28 to 33 cubic centimeters (about 2 tablespoons)

b) For the filling:

Flour		
Hard-wheat family . . .	24	$3\frac{1}{2}$ tablespoons
or		
Soft-wheat family *or* cake	30	5 tablespoons
Sugar	100	$\frac{1}{2}$ cup
Salt	. . .	$\frac{1}{4}$ teaspoon
Milk	325	$1\frac{1}{3}$ cups (315 cubic centimeters)
Eggs		
Yolks	54	3 medium sized
White	30	1 medium sized
Vanilla		$\frac{1}{2}$ teaspoon
Shredded cocoanut	70	$\frac{3}{4}$ cup
or		
Bananas	. . .	2 medium sized

Order of work

1. Prepare the pie shell as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, press the dampened material firmly together, and roll into a sheet 9–10 inches in diameter; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 2 tablespoons to a separate bowl, dampen the remainder, press the dampened particles together, roll, spread with the dry fat-flour mixture, roll up like a jelly cake, cut, press together, and re-roll into a sheet.
   b) Fit the sheet into a piepan, prick, or cover with another piepan, and bake until brown (about 12 minutes) in an oven at 450° F. As soon as the crust is baked, lower the oven regulator to 300° F.
2. Prepare the filling as follows:
   a) Weigh or measure the flour, sugar, and salt, and turn them into the top of a double boiler.
   b) Weigh or measure the milk. Add just enough of it to the dry ingredients to make a thick paste (about 2 tablespoons) and stir out any lumps.
   c) Separate the egg whites from the yolks. Set two of the whites aside for the meringue. Place the other in a bowl in which it can be beaten conveniently. Turn the yolks into the flour-sugar-milk paste and beat until well combined. Stir in the rest of the milk slowly.
   d) Cook this mixture in a double boiler until it thickens (about 15 minutes) sufficiently that a spoonful when removed and turned back falls in ridges which do not disappear for about a minute. It will have to be stirred frequently to prevent lumping.
   e) Beat the egg white until it is stiff. Immediately pour about a tablespoon of the hot mixture over the surface of the white, and with a spoon beat until the two are well mixed. Combine 4 or 5 more tablespoons of the

filling with the egg white in the same manner; then pour this egg-white mixture slowly into the hot filling, stirring the latter vigorously during the addition.

Cook this mixture in the double boiler for about 2 minutes.

f) If cocoanut is to be used, cut it into pieces about 1 inch or so long, add about two-thirds of it and the vanilla to the filling, and pour the filling into the crust.

If bananas are to be used, slice them over the crust, and then pour the filling, to which the vanilla has been added, on top of them.

3. With the egg whites left from the filling, prepare a meringue according to the directions given on page 174. Spread it over the filling. If cocoanut is being used, sprinkle the rest of it over the surface of the meringue. Brown the meringue at 300° F. (about 15 minutes.)
4. Three to 4 hours will be required for cooling at ordinary room temperature.

PINEAPPLE CREAM PIE

Approximate preparation time after a few trials

One-half hour, exclusive of the browning of the meringue.

Proportion of ingredients

a) For the crust:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family . . .	85	¾ cup
or		
Soft-wheat family *or* cake	96	1 cup
Salt	. . .	½ tablespoon
Solid fat (cold)	38	3 tablespoons
Water (cold)	. . .	28 to 33 cubic centimeters (about 2 tablespoons)

Proportion of ingredients—*Continued*

b) For the filling:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	30	4 tablespoons
or		
Soft-wheat family *or* cake	35	6 tablespoons
Sugar	134	$\frac{2}{3}$ cup
Salt	...	$\frac{1}{4}$ teaspoon
Milk	325	$1\frac{1}{3}$ cups (315 cubic centimeters)
Egg yolk	36	2 medium sized
Crushed pineapple, drained	...	$\frac{3}{4}$ cup ($\frac{3}{4}$ of a $1\frac{1}{4}$-pound can)

Order of work

1. Prepare the pie shell as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, press the dampened material firmly together, and roll into a sheet 9–10 inches in diameter; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 2 tablespoons to a separate bowl, dampen the remainder, press the dampened particles together, roll, spread with the dry fat-flour mixture, roll up like a jelly cake, cut, press together, and re-roll into a sheet 9–10 inches across.
   b) Fit the sheet into a piepan, prick, or cover with another piepan, and bake until brown (about 12 minutes) in an oven at 450° F. As soon as the crust is baked, lower the oven regulator to 300° F.
2. Prepare the filling as follows:
   a) Weigh or measure the flour, sugar, and salt, and turn them into the top of a double boiler.

b) Weigh or measure the milk. Add just enough of it to the dry ingredients to make a thick paste (about 2 tablespoons) and stir out any lumps.

c) Separate the egg whites from the yolks. Turn the yolks into the flour-sugar-milk paste and beat until well combined. Stir in the rest of the milk slowly.

d) Cook this mixture in a double boiler until it thickens (about 15 minutes) sufficiently that a spoonful when removed and turned back falls in ridges which do not disappear for about a minute.

e) In the meantime, press as much liquid as possible out of the pineapple. Measure the pineapple.

f) Remove the filling from the fire; beat until smooth; cool somewhat; add the pineapple; and turn into the shell.

3. With the 2 egg whites left from the filling, prepare a meringue according to the directions given on page 174. Spread this meringue over the filling; brown it in an oven at 300° F. (about 15 minutes).
4. Three to 4 hours will be required for cooling at ordinary room temperature.

APPLE PIE

Approximate preparation time after a few trials

One-half hour, exclusive of the baking period of about ½ hour.

Proportion of ingredients

a) For the crust:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family . . .	170	1½ cups
or		
Soft-wheat family *or* cake	192	2 cups
Salt	. . .	1 teaspoon

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Solid fat (cold)	76	6 tablespoons
Water (cold)	...	60 to 66 cubic centimeters (about $\frac{1}{4}$ cup)
b) For the filling:		
Tart apples (sliced)	567	4 cups (about 6 rather large apples)
Sugar	100 to 150	$\frac{1}{2}$ to $\frac{3}{4}$ cup
Butter	13	1 tablespoon
Nutmeg and cinnamon, if desired	...	$\frac{1}{8}$ teaspoon each

Order of work

1. Light the oven. Turn it to 425° F.
2. Wash, pare, and slice the apples into an extra piepan, cover the pan tightly and set it in the oven while the crusts are being prepared.
3. Prepare the piecrusts as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, divide the dampened material into halves, press the particles of each half firmly together, and roll each half into a sheet 9–10 inches in diameter; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 4 tablespoons to a separate bowl, dampen the remainder, divide the dampened material into 2 portions, roll each into a sheet, spread with the dry fat-flour mixture, roll up like a jelly cake, cut, press together, and re-roll into a sheet.
   b) Line the piepan with one of the sheets. Cut a design in the other one (which is to be used later as the upper crust).

4. Place about a third of the apples on the bottom crust. Sprinkle about a third of the sugar and butter, the latter cut into small pieces, on top of them. In the same manner arrange two more layers on top of the first. If spices are being used, sprinkle them on top of the last layer of apples.
5. Dampen the edge of the lower crust; place the upper crust upon the filling; press the edge of the upper crust firmly onto the lower; trim off the extra pastry.
6. Bake the pie at 425° F. until the apples are tender and the crust is a golden brown (about ½ hour). The apples are tender when a toothpick stuck through one of the holes in the upper crust goes into them easily.

RAISIN PIE

Approximate preparation time after a few trials

One-half hour, exclusive of the baking period of about ½ hour.

Proportion of ingredients

a) For the filling:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Raisins	320	2 cups (¾ of a 15-ounce package)
Lemon juice	...	¼ cup (juice of about 2 lemons)
Lemon rind (cut into small pieces)	...	½ lemon rind
Water	...	1½ to 2 cups
Sugar	100	½ cup
Flour	12	2 tablespoons

b) For the crust:

Flour		
Hard-wheat family	170	1½ cups
or		
Soft-wheat family *or* cake	192	2 cups

Proportion of ingredients—*Continued*

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Salt....................	...	1 teaspoon
Solid fat (cold).........	76	6 tablespoons
Water (cold)............	...	60 to 66 cubic centimeters (about $\frac{1}{4}$ cup)

Order of work

1. Prepare the filling as follows:
   a) Weigh or measure the raisins. Cut the lemon rind in small pieces and add it to the raisins. Soak this mixture overnight in the smaller amount of water ($1\frac{1}{2}$ cups) if the raisins are moist, or in the larger (2 cups) if they are dry.
   b) Cook in a small pan (about $1\frac{1}{2}$ quarts) for about 20 minutes or until the raisins are tender. At the end of the cooking period there should be left approximately $\frac{1}{2}$ cup liquid. If there is more, evaporate the excess; if there is less, add water.
   c) Weigh or measure the sugar and flour, mix them, then stir them with the raisins until all are well combined.
   d) Return this mixture to the fire and heat it just to the boiling-point. Stir it continually to prevent burning. As soon as it has come to a boil, remove it from the fire and set it aside to cool. Then add the lemon juice.
2. Light the oven. Turn it to 425° F.
3. Prepare the crusts as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, divide the dampened material into halves, press the particles of each half firmly together, and roll each half into a sheet 9–10 inches in diameter; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 4 tablespoons to a separate bowl, dampen the remainder, divide the dampened material into 2 portions, roll each into a sheet,

spread with the dry fat-flour mixture, roll up like a jelly cake, cut, press togther, and re-roll into a sheet.

b) Line the piepan with one of the sheets. Cut a design in the other one (which is to be used later as the upper crust).

4. Pour the filling into the lower crust, and dampen the edge of the crust; place the upper crust upon the filling; press the edge of the upper crust firmly onto the lower; trim off the extra pastry.
5. Bake the pie at 425° F. until the crust is a golden brown (30 to 35 minutes).

DRIED APRICOT PIE

Approximate preparation time after a few trials

Twenty minutes, exclusive of cooking the fruit and baking the pie.

Proportion of ingredients

a) For the filling:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Dried apricots	454	3 cups (1 pound)
Water	...	3 cups
Sugar	100	$\frac{1}{2}$ cup

b) For the crust:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	113	1 cup
or		
Soft-wheat family *or* cake	128	$1\frac{1}{3}$ cups
Salt	...	$\frac{3}{4}$ teaspoon
Solid fat	51	$\frac{1}{4}$ cup
Water	...	37 to 44 cubic centimeters (about $2\frac{2}{3}$ tablespoons)

Order of work

1. Prepare the filling as follows:
   a) Wash the fruit and soak overnight in the 3 cups of water.
   b) Cook 1 hour over a low flame in a pan with a well-fitting lid. If the pan is not well covered and the flame kept low, more water will have to be added to prevent scorching.
   c) At the end of the cooking-period, stir the sugar into the fruit. Cool at least to approximately room temperature.
2. Light the oven and set the regulator at 425° F.
3. Prepare the piecrusts as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, divide the dampened material into 2 portions (approximately two-thirds in one, and one-third in the other), press the particles of each portion firmly together, roll the larger portion into a sheet 9–10 inches in diameter, and the smaller into an oblong sheet about 10 inches long; *or* cut the fat into the flour and salt, remove about 4 tablespoons to a separate bowl, dampen the remainder, divide the dampened material into 2 portions (one about twice as large as the other), roll each into a sheet, spread with the dry fat-flour mixture, roll up like a jelly cake, cut, press together (see Figs. 48–57), and re-roll the larger portion into a sheet 9–10 inches in diameter, the smaller into an oblong sheet about 10 inches long.
   b) Line the piepan with the larger sheet. Cut the other into strips—ten (each about $\frac{3}{8}$ inch wide) is a reasonable number.
4. Pour the filling into the lower crust, and place the strips across it lattice-wise. Dampen the under side of each strip at the place it touches the crust, press it firmly onto the crust, and trim.
5. Bake at 425° F. until the crust is brown (about 20 minutes).

FRESH RED CHERRY, RASPBERRY, AND BLUEBERRY PIES

Approximate preparation time after a few trials

One-half hour for the cherry; 20 minutes for the raspberry and blueberry, exclusive of the baking period of about 40 minutes.

Proportion of ingredients

a) For the filling of the cherry and raspberry pies:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Sour red cherries	...	1 quart ($2\frac{1}{2}$ cups after pitting)
or		
Red raspberries	...	$1\frac{1}{2}$ pints
Sugar	150	$\frac{3}{4}$ cup
Flour (hard- *or* soft-wheat family *or* cake)	21	3 tablespoons

b) For the filling of the blueberry pie:

Blueberries	...	1 quart
Sugar	100 to 150	$\frac{1}{2}$ to $\frac{3}{4}$ cup
Flour (hard- *or* soft-wheat family *or* cake)	14	2 tablespoons

c) For the crusts:

Flour		
Hard-wheat family	170	$1\frac{1}{2}$ cups
or		
Soft-wheat family *or* cake	192	2 cups
Salt	...	1 teaspoon
Solid fat (cold)	76	6 tablespoons
Water (cold)	...	60 to 66 cubic centimeters (about $\frac{1}{4}$ cup)

Order of work

1. Wash the fruit. Pit the cherries, or place the raspberries or blueberries in a sieve to allow them to drain.
2. Light the oven, and turn the regulator to 425° F.
3. Prepare the piecrusts as follows (for details see pp. 162–66):
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, divide the dampened material into halves, press the particles of each half firmly together, and roll each half into a sheet 9–10 inches in diameter; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 4 tablespoons to a separate bowl, dampen the remainder, divide the dampened material into 2 portions, roll each into a sheet, spread with the dry fat-flour mixture, roll up like a jelly cake, cut, press together, and re-roll into a sheet.
   b) Line the piepan with one of the sheets. Cut a design in the other one (which is to be used later as the upper crust).
4. Measure the sugar and flour, and mix them together. Spread about $\frac{1}{4}$ of the mixture over the bottom crust.
5. Add approximately $\frac{1}{3}$ of the fruit, and then alternate layers of the sugar-flour mixture and fruit.
6. Dampen the edge of the lower crust; place the upper crust over the filling; press the edge of the upper crust firmly onto the lower; trim off the extra pastry.
7. Bake the pie at 425° F. for about 20 minutes, and then at 350° F. until the fruit is tender (about 20 minutes).

CANNED RED CHERRY OR RASPBERRY PIES

Approximate preparation time after a few trials

Twenty minutes, exclusive of the baking period of about 30 minutes.

Proportion of ingredients

a) For the filling of the cherry pie:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Sugar	150	$\frac{3}{4}$ cup
Flour (hard- *or* soft-wheat family *or* cake)	21	3 tablespoons
Canned pitted red cherries, water packed:		
Fruit	410	2 cups } one 1-lb. 3-oz. can
Juice	175	$\frac{3}{4}$ cup } one 1-lb. 3-oz. can

b) For the filling of the raspberry pie:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Sugar	50	$\frac{1}{4}$ cup
Flour (hard- *or* soft-wheat family *or* cake)	14	2 tablespoons
Red raspberries, canned in light syrup:		
Fruit	320	$1\frac{1}{2}$ cups } one 1-lb. 3-oz. can minus 2 tablespoons of juice
Juice	265	1 cup } one 1-lb. 3-oz. can minus 2 tablespoons of juice

c) For the crusts:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	170	$1\frac{1}{2}$ cups
or		
Soft-wheat family *or* cake	192	2 cups
Salt	...	1 teaspoon
Solid fat (cold)	76	6 tablespoons
Water (cold)	...	60 to 66 cubic centimeters (about $\frac{1}{4}$ cup)

Order of work

1. If uncertain as to the proportion of fruit and juice in the can, allow the fruit to drain while the crusts are being prepared.

2. Light the oven and turn the regulator to 425° F.
3. Prepare the piecrusts as follows:
   a) Cut the fat into the flour and salt, sprinkle the water evenly over the dry material until all is damp, divide the dampened material into halves, press the particles of each half firmly together, and roll each half into a sheet 9–10 inches in diameter; *or* (as described in detail on pp. 153–54 and shown in Figs. 48–57) cut the fat into the flour and salt, remove about 4 tablespoons to a separate bowl, dampen the remainder, divide the dampened material into 2 portions, roll each into a sheet, spread with the dry fat-flour mixture, roll up like a jelly cake, cut, press together, and re-roll into a sheet.
   b) Line the piepan with one of the sheets. Cut a design in the other one (which is to be used later as the upper crust).
4. Measure the sugar and flour, and mix them together. Spread about $\frac{1}{4}$ of the mixture over the bottom crust.
5. Mix the fruit and juice if they have been separated for measuring. Spread about $\frac{1}{3}$ of the fruit and juice over the lower crust, and alternate layers of the sugar-flour and fruit-and-juice mixtures.
6. Dampen the edge of the lower crust; place the upper crust over the filling; press the edge of the upper crust firmly onto the lower; trim off the extra pastry.
7. Bake at 425° F. until the crust is brown (about 30 minutes).

CHAPTER VIII

CANDY

There are two general types of candies—crystalline, such as fondant and fudges, and noncrystalline or amorphous, such as butterscotch and caramels. In the former type we want very small sugar crystals, so small that they are not perceptible to the tongue—in other words, so small that the candy feels smooth and velvety on the tongue and we do not suspect that crystals are present until the microscope reveals them. Moreover, we want the crystals to remain small as long as the candy lasts. In amorphous candies, we want no crystals when the candy is first made; nor do we want any to form on standing. If, by chance, crystals do form, the candy loses the consistency we have come to associate with it and becomes wholly undesirable. Caramels, for example, which become crystalline lose their waxy or "chewy" consistency and are no longer caramels.

The problem of candymaking is thus largely one of learning how to obtain small sugar crystals in the one type and none at all in the other. A discussion of the factors involved is given in the pages that follow. For further information on the subject see *Food Chemistry and Cookery*, chapter xii.[1]

CRYSTALLINE CANDY

EFFECT OF COOLING BEFORE BEATING

In all candies of this type, crystallization is induced by agitation or beating, and it is the temperature of the candy solution

[1] E. G. Halliday and I. T. Noble, *Food Chemistry and Cookery* (Chicago: University of Chicago Press, 1943), pp. 239–56.

at the time of beating which, more than any other factor, is responsible for the size of the crystals formed. This can be proved easily enough by boiling sugar and water together to a given temperature, then dividing the solution thus obtained into different portions and beating each at a different temperature. The photomicrographs[2] given in Figures 60–63 show what happens. Figure 60 is a picture of the crystals which formed in the solution which was beaten as soon as it was turned out of the pan, at 103° C.; while Figures 61, 62, and 63 show those which formed in the solutions cooled to 70°, 60°, and 40° C., respectively, before beating. The magnification is the same for all these photomicrographs (approximately 200 times); hence they show the relative size of the crystals formed at different temperatures, and they give definite visible evidence of the value of cooling in inducing small crystals to form.

EFFECT OF INCOMPLETE BEATING

Another point to be observed is that beating must be continued until crystallization is complete. Experience soon teaches one to recognize this stage, for it announces itself by a sudden softening followed by a stiffening. As all candymakers know, a well-cooled sugar solution is very stiff and viscous and has a glossy appearance. When such a solution is beaten, however, it gradually grows opaque, then lighter in color, and, finally, quite suddenly, it softens. Furthermore, the temperature changes, as well as the stiffness and glossiness; the candy grows considerably warmer just as the softening occurs. In a large batch of candy, sufficient heat will be liberated to make the container feel perceptibly warmer to the hand. This heat means simply that a large amount of sugar has changed from a solution to a solid, a change in state which is accompanied by an evolution of heat just as is the change of water to ice. This latter fact is well known and sometimes put to practical use by setting tubs of water in root cellars on very cold nights, the heat given off

[2] Fondant and slides for Figs. 60–69, inclusive, were prepared by Vida Wentz.

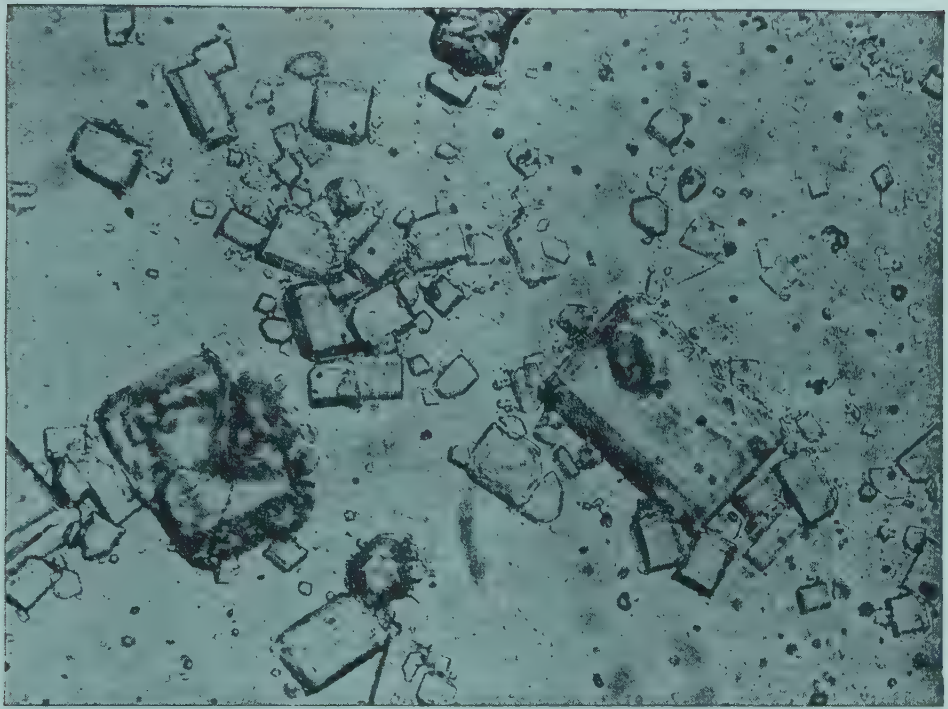


FIG. 60.—Crystals from fondant in which the syrup was beaten while hot (temperature 103° C.). Huge crystals like these mean a very granular, coarse, and crumbly candy. Magnification approximately $\times 200$.

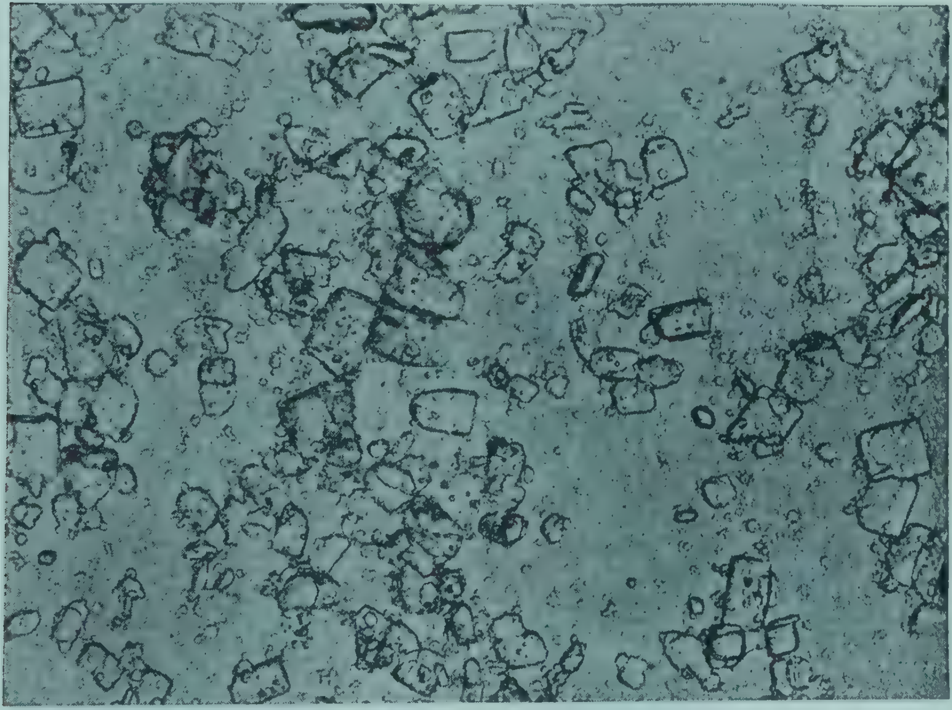


FIG. 61.—Crystals from fondant in which the syrup was cooled somewhat (temperature 70° C.) before beating. These crystals, although smaller than the ones shown in Figure 60, are still so large that they make a coarse candy. Magnification approximately $\times 200$.

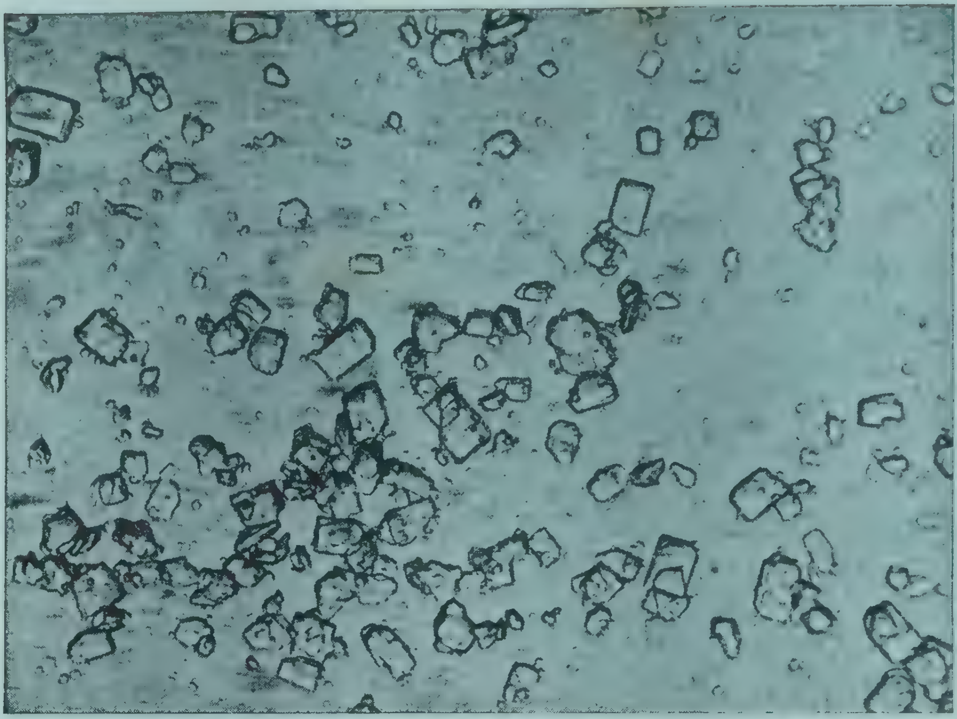


FIG. 62.—Crystals from fondant in which the syrup was cooled to 60° C. before beating. Even though these crystals are much smaller than the ones of Figure 60 and somewhat smaller than those of Figure 61, they are still so large that they form a "sugary" candy. Magnification approximately ×200.

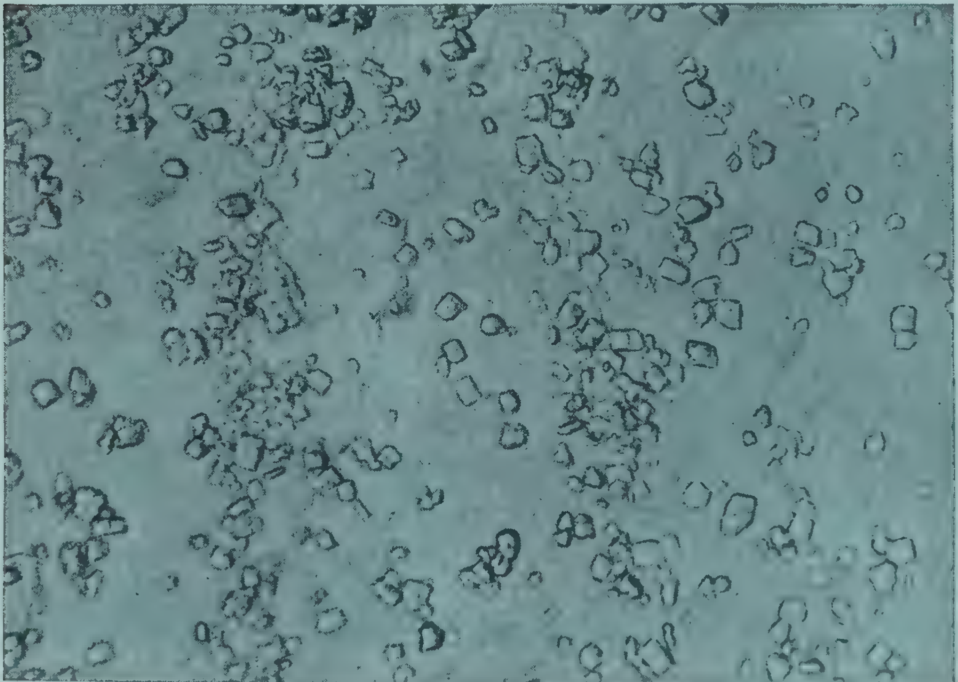


FIG. 63.—Crystals from fondant in which the syrup was cooled until it felt just warm to the hand (40° C.). Notice that these crystals are a great deal smaller than any yet shown. They are small enough to produce a pliable, creamy candy. Magnification approximately ×200.

from the freezing water being sufficient to raise the temperature of the cellar to a point above the freezing-temperature of the vegetables. When all the sugar has crystallized out of the candy solution, no more heat is given off, and the mixture begins to cool and stiffen. It is at this stage that one should stop beating and turn the candy out.

In the recipes which follow, we have tried to make conditions such that the necessary beating-period would be so short that no one would be tempted to stop too soon. This is not true of all recipes, however, as many of us know. The writers have had the exasperating experience of beating a candy mixture a full half-hour or longer without its having reached the sudden softening followed by the stiffening stage. Then, being too weary to continue, we have finally turned it out, to find that, upon standing, it had become coarsely crystalline, so coarse that the crystals were perhaps visible to the naked eye—at any rate, perceptible to the tongue. Figures 64 and 65 show samples of the very same batch of candy, Figure 64 representing that removed *before* and Figure 65 that removed *after* complete crystallization had occurred.

USE OF FOREIGN MATERIALS

In order to obtain very small crystals, and especially crystals which will remain small through a considerable period, such as that which elapses between the time Christmas candies are made and eaten, certain substances other than cane (or beet) sugar will have to be used. These substances, for the sake of simplifying the discussion, are designated as "foreign" material, regardless of their nature. For fondant, this foreign material is usually corn syrup or some kind of acid, such as cream of tartar; for fudge, it is either corn syrup and cream or corn syrup, milk, and butter. Such substances appear to act as interference during crystallization and make it difficult for sugar molecules to collect in groups of sufficient size to form large crystals. The effect of one of them (or rather of the products formed by it [p. 198]) can be seen by comparing the size of the crystals in Figure 66, representing candy made from sugar and water alone, with the

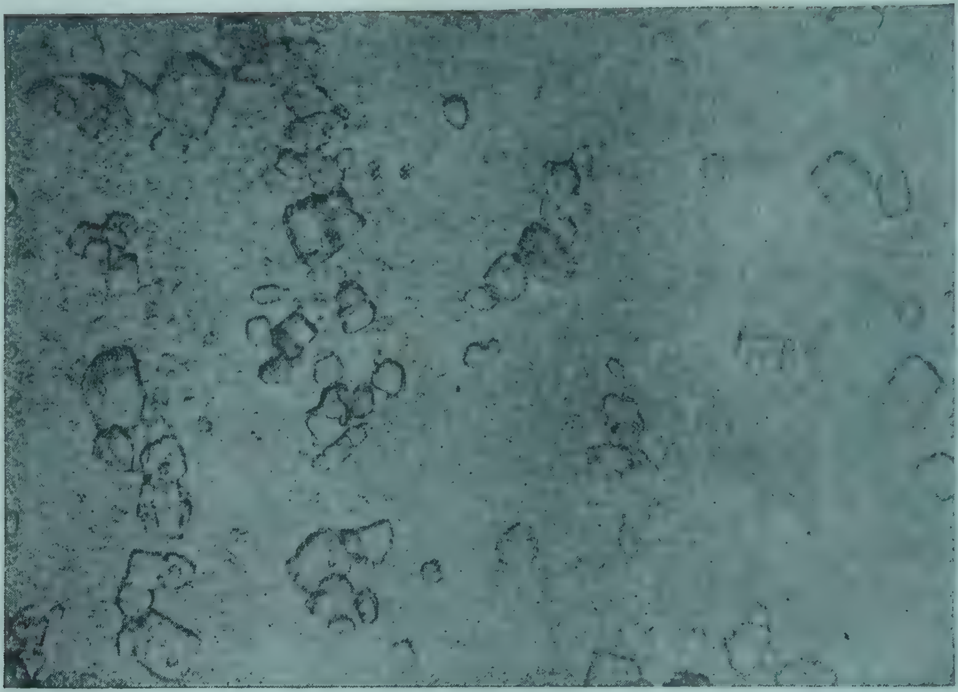


FIG. 64.—Crystals from fondant in which the syrup was not beaten long enough for it to stiffen. Large crystals like these form whenever fondant (or fudge) is poured into the cooling pan too soon and hardens only upon long standing. Magnification approximately ×200.

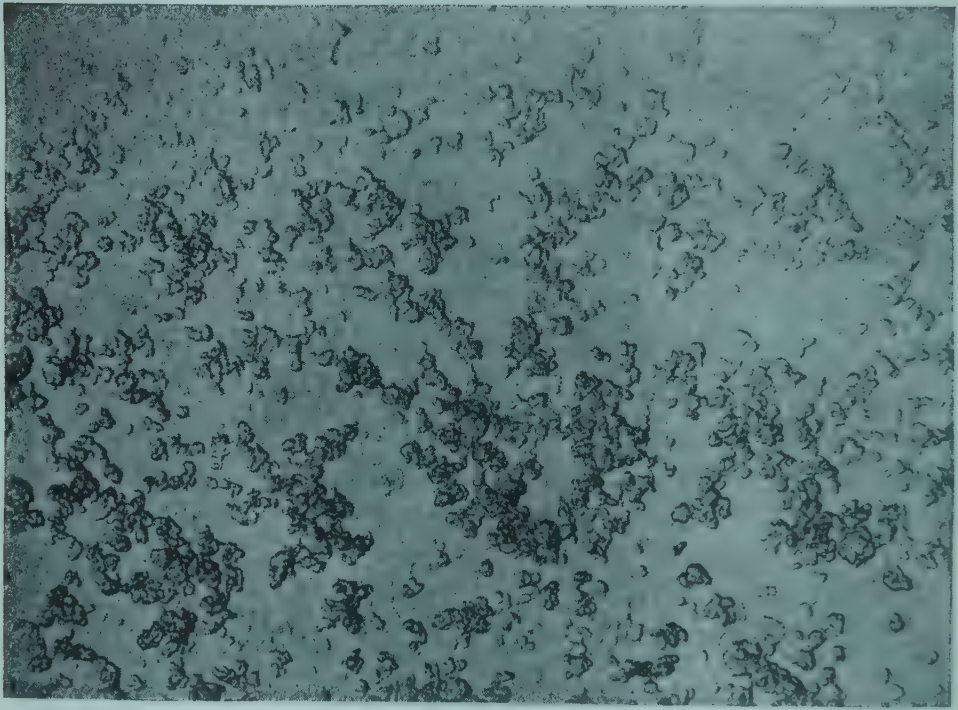


FIG. 65.—Crystals from the same batch of fondant as those shown in Figure 64. However, with this part of the syrup, the beating-period was continued until the candy had become stiff—in other words, until crystallization was complete. Magnification approximately ×200.

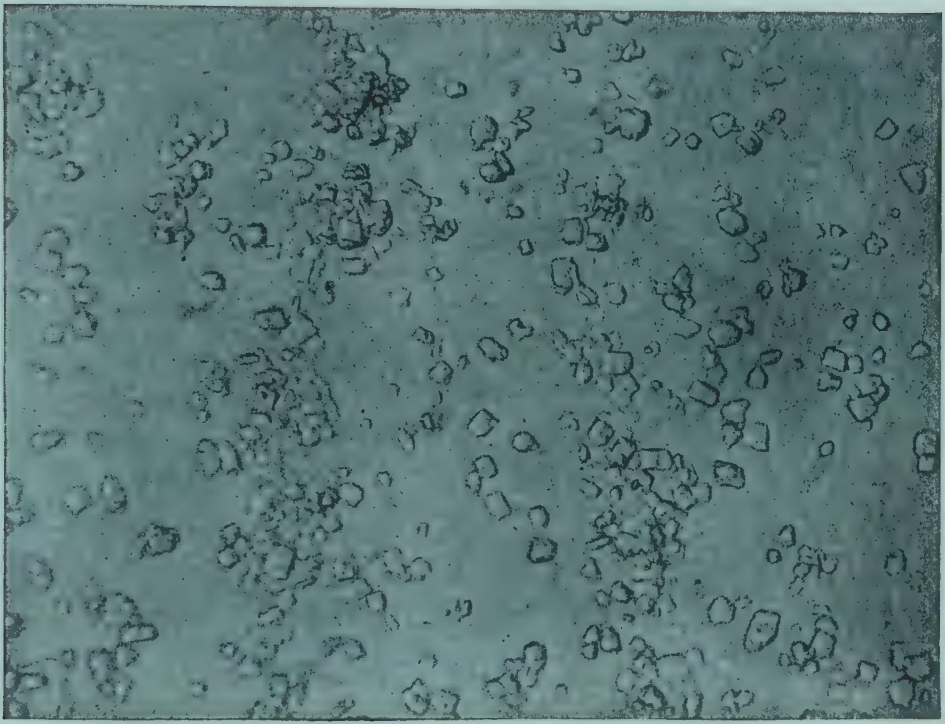


FIG. 66.—Crystals from sugar-and-water fondant, photographed as soon as prepared. Magnification approximately ×200.

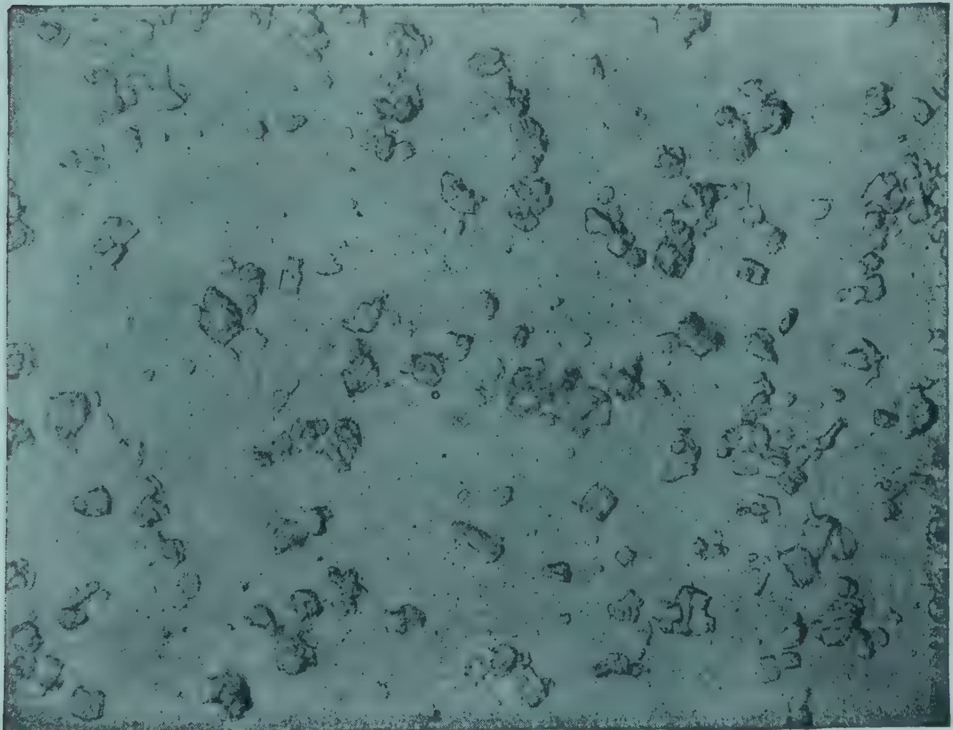


FIG. 67.—Crystals from the same fondant as shown in Figure 66, photographed after standing 17 days. As may be noted by comparing these two figures, the crystals have grown larger upon standing. Magnification approximately ×200.

appreciably smaller ones of Figure 68, in which cream of tartar was used.

The work of foreign materials does not cease at the time that the crystals form but continues during the storage period and tends to retard crystal growth. No matter how small the crystals are when formed, they are never uniform in size; some are bound to be larger than others. On standing, if nothing is present to interfere with the natural course of events, the large crystals, like large corporations in the presence of small ones, grow larger, while the small ones tend to disappear. This tendency is well brought out by the crystals shown in Figures 66 and 67, representing fondant made from sugar and water. Those of Figure 66 were photographed immediately after the candy was made; those of Figure 67, seventeen days later. It will be observed that the crystals of the stored fondant are perceptibly larger than the ones of the fondant just made.

By contrasting the crystals of Figures 66 and 67 with those shown in Figures 68 and 69, the effect of foreign material in retarding crystal growth is seen. The fondant of Figure 69, like that of Figure 67, was photographed seventeen days after it was made; but, unlike that of Figure 67, it contained cream of tartar, and, as a result, the crystals show no material increase in size over the ones of the same kind taken immediately after the candy was made (Fig. 68).

Important as are foreign substances in the making of crystalline candies, there is such a thing as having too much of them, in which case we may not be able to induce crystallization at all or, if we do, it will be only after what seems endless beating. The danger of getting too much lies mostly in the use of acid. This is a point of considerable importance and calls for some discussion.

Acid.—First, it must be understood that it is not acid *as such* but rather the substances produced by acid from sugar which interfere with crystal formation and growth. These substances are glucose and levulose in equal quantities, a mixture which sometimes is given the name of "invert sugar." The levulose of

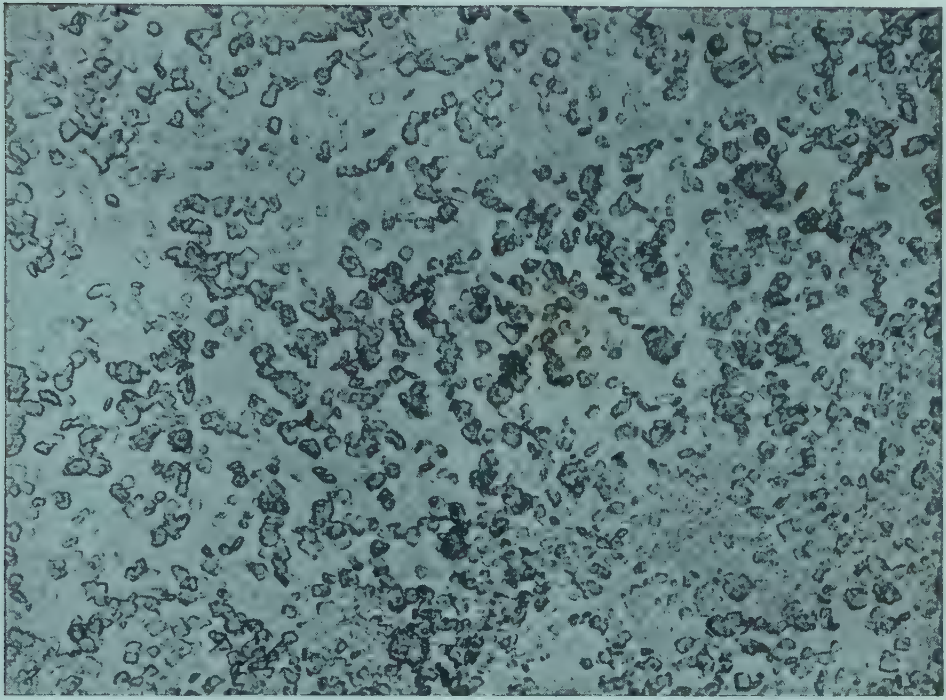


Fig. 68.—Crystals from sugar, cream of tartar, and water fondant, photographed as soon as prepared. A comparison of these crystals with those in Figure 66 shows that the use of cream of tartar in preparation of fondant decreases the size of the crystals formed and therefore makes a more creamy candy. Magnification approximately ×200.

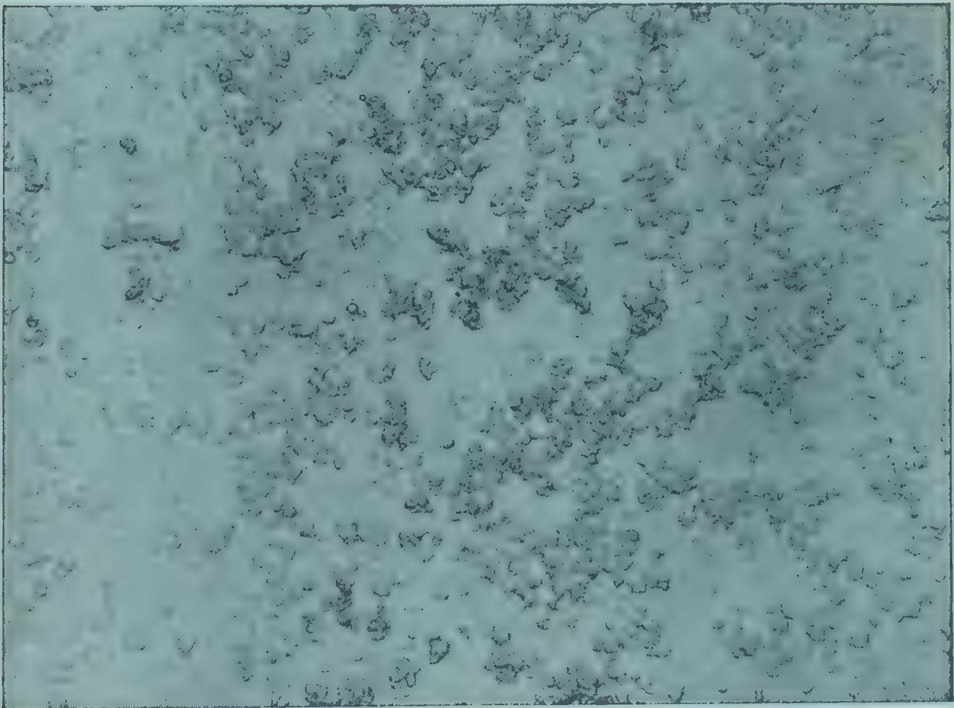


Fig. 69.—Crystals from the same fondant as shown in Figure 68, photographed after standing 17 days. By comparing these crystals with those of Figure 68, it can be seen that cream of tartar tends to prevent the growth of crystals in fondant. Magnification approximately ×200.

the mixture is particularly efficient in preventing the formation and growth of crystals in candy; and if ever it is available in a pure state at a reasonable price, it will probably be used in large quantities in candymaking. At present the pure substance costs around twenty dollars a pound; hence the only way we can hope to have it in candy is to make it on the spot along with its partner, glucose, from cane sugar, either by heating with acid as just mentioned or by use of the enzyme invertase. The latter method is not practicable for home candymaking, hence will not be discussed here. Its use, however, has certain advantages for commercial work, as is set forth in an article by Paine.[3]

The amount of invert sugar formed from sucrose at a given temperature depends chiefly on two variables—the concentration of the acid and the time through which it is allowed to act. At first thought it might seem easy enough to control the first of these, but such is not the case. Even if two candymakers use exactly the same acid in exactly the same proportion, the acidity of their candy solutions may not be the same, because, as already stated in the vegetable discussion, most natural waters contain more or less free alkali and therefore neutralize some portion of the acid added. If the two workers chance to use water of the same alkalinity, well and good; if not, there is trouble. One way out of the difficulty is for everybody to use water which is practically neutral, such as distilled or rain water or that obtained by melting clean ice or snow, in which case all should obtain the same acid concentration if the ingredients used are carefully measured.

It will be noted that in our fondant recipe (p. 207) we have given two proportions of acid, that for distilled or rain water and that for Chicago city water, which contains considerable free alkali, about as much as the most alkaline of the waters we have tested. The chances are, then, that the proportion of acid which should be used with natural waters throughout the country is either the same as we use with Chicago water or less,

[3] "Constructive Chemistry in Relation to Confectionary Manufacture," *Industrial and Engineering Chemistry*, XVI (1924), 513.

but, of course, not less than the proportion given for distilled water.

Fixing the concentration of acid, however, will not avail unless at the same time we make the length of the cooking-period a constant. Since in a hot solution the acid is busily at work changing sucrose to invert sugar, it follows that the longer we heat the solution, the more invert sugar we shall have. It is, indeed, quite possible to get so much that our cooled solution crystallizes with great difficulty. We can duplicate our own or someone else's boiling-period fairly well for given quantities of ingredients if we use kettles of similar size and shape and keep the solutions boiling briskly. Trouble comes in changing to a kettle of another shape—from a deep to a shallow one or the other way around—and by this means changing the rate of evaporation, or in using different quantities of ingredients. Thus, one worker in our laboratory took twice the quantity of materials called for in the original recipe and heated the mixture over a small gas burner, with the result that it took 40 minutes for the solution to reach the desired concentration, as against 20 minutes for the small recipe. During this long heating-period such a large amount of invert sugar was formed that it took 30 minutes' beating, in place of the usual 6 or 7 minutes, to induce crystallization.

In our fondant recipe calling for cream of tartar, we have described the kettle used. If such a kettle is available and the mixture is kept boiling continuously, little difficulty should be encountered in duplicating our boiling-time.

Corn syrup.—Unlike acid, corn syrup, *as such*, interferes with the crystallization of cane sugar. One of its components is glucose, which is exactly the same as the glucose formed from cane sugar by the action of acid; another is dextrin, which closely resembles starch and forms a thick, viscous mixture when cooked.

In so far as they interfere with crystallization, corn syrup and invert sugar appear to be about equally effective, with the advantage slightly in favor of the latter. In certain other ways,

however, corn syrup is to be preferred to invert sugar. With the former, one does not have to worry about the reaction of the water used or, within reason, the length of the boiling-period; for, regardless of these, the substances present at the end of the cooking-period are about the same as at the beginning. Furthermore, corn syrup picks up much less water in damp weather than does the levulose of invert sugar. In spite of these manifest advantages in the use of corn syrup, many of us, however, still cling to acid in making fondant because of the slightly better consistency given by invert sugar as against that given by corn syrup. Owing probably to its dextrin, the latter gives a fondant which tends to be somewhat viscous and sticky.

NONCRYSTALLINE OR AMORPHOUS CANDY

In amorphous candies such a large proportion of foreign substances is added that it is impossible for enough sugar molecules to get together to form one single crystal. In the brittle variety, of which butterscotch is an example, it is customary to use both corn syrup and an acid, usually vinegar or lemon juice. The acid is added to give flavor and to make the candy brittle rather than waxy, as would be the tendency if only corn syrup were used. One must be especially careful to use no more acid than the recipe calls for and to keep the boiling-time short. Otherwise, so much invert sugar will be formed that in damp weather the candy will become sticky, owing to the tendency of the hygroscopic levulose to pick up water.

In waxy candies, such as caramels, huge quantities of three foreign materials—corn syrup, cream, and butter—are used. The only difficulty in making such candies is to cook to the desired consistency without scorching the mixture. This means constant stirring during the latter part of the cooking-process.

CANDY TESTS

COLD-WATER TEST

The common household practice of cooking a candy solution until a cooled portion has the consistency of a soft or hard ball

or until it cracks gives fairly good results for an experienced person. This is true in spite of the fact that there is no sharp distinction between one kind of ball and another and that, as a consequence, it takes rather a nice discrimination to select just that consistency which will give the best results. Such discrimination comes only with experience in correlating the look and feel of certain candy balls with certain results, good or bad, in the finished candy. The task of learning to do this is usually accompanied by a few failures; but the number of these can be greatly lessened if the beginner will carry out her tests as follows:

1. Use a small bowl freshly filled with cold water for cooling each sample of syrup. Cups and saucers, both of which candymakers are prone to use, are most unhandy, cups being of inconvenient shape for removing samples and saucers too shallow to permit proper cooling.

While the test is being made, set the pan of syrup off the fire. This is to prevent overcooking, provided the desired consistency has been reached by the time the test is started.

2. Turn about half a teaspoon of the hot syrup into the bowl of cold water. Note how it behaves when it strikes the water. After it has cooled, pick it up to judge its consistency.

If the syrup stays together in one mass when it strikes the water rather than scattering out or disappearing altogether and if it can be collected immediately and easily by the fingertips into a ball which feels very soft and flattens when laid upon the fingers, yet shows no tendency to ooze between them, it has reached the soft-ball stage. This is the consistency for fondant and fudges.

If, when brought above the surface of the water, the ball feels plastic but yet is hard enough to hold its shape, the hard-ball stage has been reached.

If the syrup separates into threads when it strikes the water and if these threads are hard but not brittle, the syrup has reached the consistency required for caramels.

THERMOMETER TEST

The most reliable method of testing a candy mixture is with the thermometer, but even this method can come to grief in the hands of the inexperienced or the unthinking. Probably the most common cause of trouble is faulty technique in reading the thermometer. To read it correctly, that part of the scale being read should be on a level with the eye; if it is below eye level, the reading is too high; if above, the reading is too low. Furthermore, when the reading is taken, the bulb of the thermometer should be completely covered by the liquid, not simply by the foam at the top, and it should not touch the pan at any point. And, of course, it should be read while the liquid is boiling. It may seem absurd that anyone should need to be given such instructions, yet, strangely enough, a good many do. We have seen students who have been told to read the thermometer on the eye level remove the pan from the fire and hold it in such a position that the right spot on the thermometer scale came opposite the eye, thus performing this part of the operation correctly, but at the same time introducing an error many times greater than could ever occur by reading the thermometer in the wrong position. Worse yet, we have seen them remove the thermometer from the boiling solution and hold it up where it could be read conveniently, apparently not noticing that the mercury was making a swift descent toward its resting place at room temperature.

Another possible source of error lies in the assumption that there is one universal temperature which can be relied upon to give a soft-ball or any other consistency for all candy solutions. This, of course, is not so. All that the temperature tells is the concentration—in other words, the number of particles present per unit volume. If two candy solutions boil at the same temperature, the concentration may be the same but not necessarily the consistency, for the latter depends upon the nature of the particles present, as well as upon their number. For example, if we had two candy solutions boiling side by side, one containing considerable corn syrup along with cane sugar, the other cane sugar alone, and if we boiled the two to exactly the same

temperature and tested their consistency by the cold-water test, we should find that the solution containing the corn syrup with its viscous, starchlike dextrin made a much stiffer ball than the one containing cane sugar alone. Thus it is that we can depend upon the temperature to indicate the consistency only for a certain definite combination of ingredients. In other words, a change in the recipe is likely to be accompanied by a change in the temperature of the candy test.

A third possible source of trouble in testing a candy solution with a thermometer is the failure to realize that each set of temperature tests holds good only for a given atmospheric pressure. This means slight temperature variations in candy tests from time to time, particularly in winter, when the air pressure shows its greatest variation. In Chicago, for example, the pressure in one year ran anywhere from 726.4 to 764.5 millimeters of mercury, hence the boiling-point of water varied from 98.7 to 100.2° C., a difference of 1.5° C. (2.3° F). Such differences should be taken into account in making candy tests if the latter are to be relied upon absolutely. Small differences can be corrected for with sufficient accuracy for our purpose by finding the temperature at which water boils and adding to that temperature the number of degrees above 100° C. called for in the candy test. Thus, if water boils at 98° C., a candy test of 115° C. would be corrected to read 113° C. Such a correction also helps to take care of any error which may arise from faulty calibration of the thermometer.

The chances for error just discussed have been considered in formulating the directions which follow for testing candy solutions with a thermometer.

Laboratory-thermometer test.—1. Select a thermometer with a short bulb, anywhere from $\frac{1}{2}$ to $\frac{3}{4}$ inch in length and preferably one with a long scale, such as is found in those registering from 0° to 150° C. A short bulb is easily covered, even by small portions of candy; and a long scale is easily read, since in such scales the graduation marks are farther apart than in short ones.

2. Suspend the thermometer in such a way that its bulb is well covered by the solution before boiling begins but so that it does not touch the bottom or sides of the pan. To lessen the chances of breaking the thermometer, tie it in place with a string, thus leaving it free to swing if accidentally touched and making it possible to move it to one side if the mixture is one that has to be stirred, such, for example, as caramels.

3. Keep the liquid boiling while reading the thermometer and have the eye on the level with that part of the scale being read.

4. Take the temperature of boiling water and add to this temperature the number of degrees above 100° C. specified in the candy test.

Candy-thermometer test.—1. Attach the thermometer to the kettle at such a height that the bulb is well covered by the liquid before it starts to boil but, at the same time, at such a height that the thermometer frame does not touch the bottom of the kettle.

2. Keep the liquid boiling while reading the thermometer and have the eye on the level with that part of the scale being read.

3. Take the temperature of boiling water and add to this temperature the number of degrees above 212° F. specified in the candy test.

COMBINATION THERMOMETER AND COLD-WATER TEST

In view of the difficulties involved in making an absolutely reliable thermometer test, some home candymakers prefer to make a combination thermometer and cold-water test. This is done simply by boiling the candy to a temperature about 3° or 4° lower than that called for in the directions, then removing the kettle from the fire and testing the syrup by the cold-water method. If the consistency does not appear to be the desired one, the candy is put back over the fire and heated just to boiling, then retested. This process is repeated until the desired consistency is reached. By such a procedure as this, one soon becomes quite expert in judging the consistency required for various types of candy.

DIRECTIONS FOR THE PREPARATION OF CANDY[4]

GRANULATED-SUGAR FONDANT

Yield

About $1\frac{1}{4}$ pounds.

Utensils

Cooking-pan: capacity, 2 quarts; the one used in this laboratory is $6\frac{1}{2}$ inches in diameter.

Cooling dish: a smooth platter or shallow glass baking dish of at least 1-quart capacity.

Proportion of ingredients

a) For cream-of-tartar fondant:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Sugar	600	3 cups
Cream of tartar		
When distilled (or rain) water is used	0.4	$\frac{3}{16}$ teaspoon
When slightly alkaline (pH 8.4 to 8.6) water is used	0.8	$\frac{3}{8}$ teaspoon
Boiling water	.....	$1\frac{1}{2}$ cups

b) For corn-syrup fondant:

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Sugar	600	3 cups
White corn syrup	30	2 tablespoons
Boiling water	.....	$1\frac{1}{2}$ cups

Order of work: Detailed form

1. Weigh or measure the sugar and the cream of tartar or corn syrup; turn them into the cooking-pan.
2. Weigh or measure the boiling water. Stir it with the sugar mixture until all the sugar has dissolved. If the last of the sugar does not go into solution easily, the syrup may be

[4] Measurement of the ingredients used in candy will give proportions sufficiently accurate for home cooking. Cream of tartar, if not weighed, however, should be measured carefully.

heated over a low flame. Stop stirring as soon as the sugar has dissolved and do not stir the mixture again.

3. When a thermometer is used, place it in such a position that its bulb is covered by the syrup but does not touch the pan.
4. Set the dish in which the syrup is to be cooled in a warm place.
5. Cook the syrup as follows:
   a) Bring quickly to a boil and boil briskly. If a gas burner is being used, regulate the flame so that it comes in contact with the entire bottom surface, but not with the sides, of the pan.

      In cream-of-tartar fondant, the amount of heat should be so regulated that the cooking-period takes about 20 minutes.

   b) With a damp cloth wrapped around the tines of a fork, remove any crystals that collect above the syrup.
   c) Cook to the soft-ball stage (115° C. [239° F.]). (For method of testing for this stage see p. 202.) Remove from the fire, let stand in the pan until all the bubbles have disappeared, then pour into the cooling dish as much of it as will drain from the pan of its own accord. (Do not scrape the pan, for such agitation will cause crystallization to start.)
6. Cool the syrup as follows:
   a) Set it on a rack where it will cool from the bottom as well as from the sides.
   b) Cool to 40° C. (104° F.) or until the platter can be held comfortably upon the hand. At room temperature this will take about 45 minutes.
7. With a wooden spoon, beat the syrup until it becomes white and solid enough to handle (about 5 minutes), then pick it up and work it with the hands until all lumps have disappeared. Place it in a jar, cover it with a damp cloth and with the lid of the jar. Let it stand for about 24 hours before using.

Order of work: Abbreviated form

If the person who makes this candy chooses to use cream of tartar and distilled (or rain) water and to measure the ingredients, a résumé is somewhat as follows:

1. Proportion of ingredients:

Sugar	3 cups
Cream of tartar	$\frac{3}{16}$ teaspoon
Boiling water	$1\frac{1}{2}$ cups

2. Mix the three ingredients together, being sure that the sugar is completely dissolved before the syrup reaches the boiling-point.
3. Cook to the soft-ball consistency (115° C. [239° F.]) in about 20 minutes.
4. Pour into a warm, fairly shallow baking dish and cool to 40° C. (104° F.).
5. Beat, then knead.

BROWN-SUGAR FONDANT

Yield

About $1\frac{1}{2}$ pounds.

Utensils

Cooking-pan capacity, 2 quarts; the one used in this laboratory is $6\frac{1}{2}$ inches in diameter.

Cooling dish: a smooth platter or shallow glass baking dish of at least 1-quart capacity.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Light-brown sugar	390	2 cups
Granulated sugar	400	2 cups
Boiling water	...	2 cups

Order of work

1. Weigh or measure the ingredients. Turn them into the cooking-pan, and stir until the sugar has dissolved. If the

last of the sugar does not go into solution easily, the syrup may be heated over a low flame. Stop stirring as soon as the sugar has dissolved, and do not stir the mixture again.

2. When a thermometer is used, place it in such a position that its bulb is covered by the syrup but does not touch the pan.
3. Set the dish in which the syrup is to be cooled in a warm place.
4. Cook the syrup as follows:
   a) Bring quickly to a boil and boil briskly. If a gas burner is being used, regulate the flame so that it comes in contact with the entire bottom surface, but not with the sides, of the pan and, moreover, so that the cooking-period takes about 20 minutes.
   b) With a damp cloth wrapped around the tines of a fork, remove any crystals that collect above the syrup.
   c) Cook to the soft-ball stage (115° C. [239° F.]). (For method of testing for this stage see p. 202.) Remove from the fire, let stand in the pan until all the bubbles have disappeared, then pour into the cooling dish as much of it as will drain from the pan of its own accord. (Do not scrape the pan, for such agitation will cause crystallization to start.)
5. Cool the syrup as follows:
   a) Set it on a rack where it will cool from the bottom as well as from the sides.
   b) Cool to 40° C. (104° F.) or until the platter can be held comfortably upon the hand. At room temperature this will take about 45 minutes.
6. With a wooden spoon, beat the syrup until it loses its stickiness and becomes a light-brown creamy mass solid enough to handle (6 or 7 minutes), then pick it up and work it with the hands until all lumps have disappeared. Place it in a jar, cover it with a damp cloth and with the lid of the jar. Let it stand for about 24 hours before using.

FONDANT CONFECTIONS

Fondant is used in the preparation of a great variety of confections, a few of which will be discussed here.

BONBONS

Bonbons are two-layer candies—one layer being of molded fondant, with or without the addition of fruit or nuts, the other of melted fondant, usually colored, which hardens to give a smooth, glossy covering. The processes involved in making bonbons are coloring and flavoring the fondant, preparing the centers, melting the fondant for dipping the centers, and, finally, dipping them. Each of these processes is discussed separately.

Coloring fondant.—We use Burnett's pastes for coloring candy. These pastes can usually be obtained from a local grocer or confectioner; but, if not, then from the manufacturer. They are concentrated and must be used in very small quantities indeed, if the candy is to be delicate and attractive in appearance rather than vivid and poisonous looking. To make sure that we do not use too much, we add them from the point of a toothpick.

If the fondant is for centers and is *not* melted, we work the coloring in with the hands by adding just a little bit at a time, working each portion in before adding another, repeating the process until the desired shade is reached. Such centers are usually not dipped but are rolled in cocoanut or chopped nuts. If the fondant is for dipping and therefore melted, we add the coloring during the melting process, a small portion at a time, as for the unmelted.

The colors usually preferred for bonbons are rose, green, and yellow—all in delicate pastel shades.

Flavoring fondant.—The flavoring is added at the same time as the coloring and, in case of peppermint, wintergreen, or other concentrated substances, in very small portions to avoid using too much.

Shaping bonbon centers.—Bonbon centers may be shaped by rolling small pieces of the prepared fondant between the palms

of the hands with a rotary motion to form small balls. A convenient size is $\frac{3}{4}$ inch in diameter, which means that the finished bonbon is about 1 inch across. After shaping, the centers are allowed to stand for from 3 to 12 hours—the time depending on the weather and one's convenience—in order to crust the outside so that they will keep their shape when dipped.

In general, it is desirable to add fruit or nuts or a combination of the two to fondant centers, since those made of fondant alone are oversweet. Suggestions for single additional substances and for combinations are given on page 214. If any of these are used, they should be worked into the fondant along with the coloring and flavoring.

Dipping bonbons.—(*a*) Utensils: We use an improvised double boiler for melting the fondant and dipping the bonbons. This consists of two shallow pans fitted together, one slightly larger than the other, the inner one with a capacity of about a pint. Such an arrangement is more convenient than a regular double boiler with its deep inner pan from which it is awkward to remove the bonbons.

For turning the bonbons and lifting them from the melted fondant, we use a dipper copied by a laboratory technician from one in the possession of Ruth Lehman, of Ohio State University. It consists of a piece of heavy wire, looped and sealed into a metal handle. The loop is 2 inches long and $\frac{1}{2}$ inch wide, outside measure; the handle is 6 inches long. Before we acquired this dipper, we used a steel fork from which the center tines had been removed.

For receiving the coated centers, we use a molding board covered with waxed paper. From such a surface the bonbons can be removed without fear of cracking their delicate outer shells.

b) Melting the fondant: We use about $\frac{3}{4}$ pound (1 cup) of dipping fondant at a time. This fills the inner pan of our improvised double boiler just about half-full. Less than this is soon reduced to the point where it will not coat the bonbons evenly and, moreover, cools so rapidly that it must be reheated frequently. If

much more is used, quite a large quantity will have to be discarded at the last because it has become grainy with the constant agitation occasioned by dipping the bonbons.

During melting, the unsoftened fondant will have to be turned over from time to time but should be stirred very little, for agitation causes the formation of large crystals. Such crystals are particularly undesirable in colored bonbons because they form white patches which give the candy a mottled effect.

As soon as the lumps have disappeared and the whole mass has become mobile, but is still thick—about the consistency of cold corn syrup—the fondant has melted sufficiently to be used for dipping and is ready to be removed from the hot water and placed near the waxed-paper-covered surface prepared to receive the bonbons.

c) Coating the centers: A center is picked up with the fingers and dropped right side up—that is to say, rounded side up—into the melted fondant and is immediately turned over gently with the candy dipper. During the turning process it should be completely coated with melted fondant; if it is not, there is insufficient fondant in the pan. After the turning, the dipper is slipped under the candy in such a manner that the rounded side rests upon it. In this position, the two are brought out of the molten material, are held above the pan until the draining fondant drops in long fine threads, and then are carried to the waxed paper. When about an inch above the paper, the piece of candy is quickly inverted, so that for a moment it hangs from the dipper. Soon, however, it drops, right side up, onto the paper. As it does so, it may break away sharply from the fondant clinging to the dipper, or it may spin a thread which can be wound as a design upon the top of the bonbon.

After the candy leaves the dipper, the coating should be stiff enough so that it remains on the bonbon in a thick layer. If it runs off, forming a base around the candy, the dipping fondant is too hot and should be cooled for a few minutes before being used again. If, on the other hand, the coating is not smooth and

glossy but tends to be rough and uneven, the dipping fondant has become too cool and should be remelted.

Sometimes it happens that fondant, after having been melted once, does not soften upon heating again, but remains dry and crumbly. If this occurs, a few drops of hot water will cause it to soften. The water must be added slowly, drop by drop, for very little is required to moisten the candy and an excess will make it too soft. The last little bit of fondant left in the dipping-pan usually hardens, but this small amount is seldom worth the trouble of remelting, for almost invariably it has become grainy and therefore undesirable.

The bonbons should not be removed from the waxed paper until their coatings are perfectly solid.

SUGGESTIONS FOR BONBONS AND THEIR DERIVATIVES

A. Suggestions for centers
1. White-sugar fondant, flavored, uncolored
2. White-sugar fondant, flavored, colored
3. White-sugar fondant, flavored, plus:
    a) Half, quarter, or chopped nut meats
    b) Shredded cocoanut
    c) Candied fruit (either mixed with the fondant or placed in the center of the fondant):
        1) Cherries
        2) Pineapple
    d) Dates[5]
    e) Dried figs
    f) Combinations of any of the above, as a date-fig-nut mixture
4. Brown-sugar fondant, either alone or mixed with any of the things mentioned under 3
5. Brown-sugar fudge, alone or mixed with any of the substances mentioned under 3

[5] Dark-colored centers should be covered with a coating which masks their color, such as brown-sugar fondant or fudge.

B. Suggestions for coverings for centers:
  1. Covered before hardening:
    a) Roll in almonds, which have been prepared by blanching, drying, browning, and then chopping
    b) Roll in chopped, shredded cocoanut
  2. Allowed to harden, then covered by dipping into melted fondant or fudge:
    a) White fondant, different flavors
    b) Tinted fondant, different flavors
    c) Brown-sugar fondant
    d) Brown-sugar fudge
    e) Chocolate fudge
    f) Dipped into any of the above fondants or fudges and rolled immediately after dipping in chopped almonds or shredded cocoanut

CANDY LOAF

Another decorative use for fondant is candy loaf, which is fashioned in layers like brick ice-cream. A pleasing combination for this is two layers of fondant, one white, the other rose colored, with a layer of brown-sugar nut fudge in the center. Three layers of fondant may, of course, be used, in which case we suggest that the center one contain nuts or some kind of fruit, such as dates, figs, or candied fruit.

If one has the fondant prepared, the next step is the selection of a pan for molding it, preferably one about $1\frac{1}{2}$ inches deep. This depth is sufficient to show off the three colored layers advantageously when the loaf is cut. The capacity of the pan should be determined in order to know approximately the quantity of fondant or fudge to allow for each layer. For example, if the tin holds 4 cups of water, a total of 4 cups of candy are required. This amount can be apportioned as desired, but the result is a little more pleasing if the top and bottom layers are of approximately the same thickness.

In order to enable one to handle the candy easily when it is ready to be cut, the pan in which it is molded should be lined

with heavy waxed paper, which should stand 1 or 2 inches above the rim.

When the pan is ready, the fondant for the bottom layer is melted over hot water in any sort of double-boiler arrangement that is convenient; flavored and colored according to the directions under bonbons; turned out and spread over the entire surface of the pan in a fairly even layer. Any time after the first layer cools enough to set, the second layer is added, and then the third. If the second layer is fudge, it can be turned directly into the pan as soon as it is beaten, provided the bottom layer is ready at that moment to receive it. If not and if the fudge cools, it will have to be melted in the same manner as fondant.

When ready to be cut, the loaf is lifted out of the pan and cut into slices about $\frac{1}{2}$ inch wide, which are again divided into sections about $1\frac{3}{4}$ inches long. If the candy is to be packed or kept any length of time, the sections should be wrapped in heavy waxed paper in order that they may retain their shape and not dry out.

MINTS

After-dinner mints, like other fondant confections, may be flavored and colored to suit the individual's taste. For these the fondant is melted just as for dipping—namely, in rather small quantities in a shallow pan over hot water—and is flavored—a drop of oil of wintergreen or peppermint is often used—and colored, if desired. (For a detailed description of melting, flavoring, and coloring see p. 211.) The fondant is then removed from the heat and set near some oiled paper, which previously has been spread over an even surface. A teaspoon is filled about half-full of the melted fondant—the amount depending upon the size desired for the finished mint—and then the fondant allowed to run from it onto the paper. If the candy is of the right consistency, it will slowly spread out into a disk about the size of a 25-cent piece. When most of the fondant has left the spoon, a thread may extend between the mint and the spoon. This may be broken by winding it into a pattern on top of the candy. As soon as one mint is finished, another should be made.

After several have been completed, the spoon will be coated with a thick layer of hard fondant. This should be scraped off into another dish and the dropping continued as before.

CHOCOLATE FUDGE

Yield

One and one-quarter pounds, or 25 pieces, $1\frac{1}{4}$ inches by 1 inch by $\frac{3}{4}$ inch.

Utensils

Cooking-pan: capacity, 3 quarts.

Molding pan:[6] capacity, 1 quart. The one used in this laboratory is $6\frac{1}{2}$ inches by 5 inches by $1\frac{3}{4}$ inches.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Bitter chocolate..........	57	2 squares
Sugar....................	400	2 cups
Corn syrup..............	10	2 teaspoons
Coffee cream (18 per cent)[7]	239	$\frac{1}{2}$ pint
Salt.....................	...	$\frac{1}{4}$ teaspoon
Vanilla..................	...	$\frac{1}{2}$ teaspoon
Nut meats, if desired ($\frac{1}{4}$ pound)................	113	1 cup

Order of work

1. Combine the ingredients as follows:
   a) Place the chocolate in the cooking-pan and set this pan inside another containing hot water until the chocolate has melted.
   b) Mix the sugar thoroughly with the melted chocolate; then add the corn syrup, salt, and cream, and stir until all are well combined.

[6] For lack of a better term, we are designating the pan in which the finished candy is cooled as the "molding pan."

[7] One-half cup evaporated milk plus $\frac{1}{2}$ cup water plus 2 tablespoons butter may be substituted for the cream.

2. Bring the syrup slowly to the boiling-point, stirring most of the time. Cook to the soft-ball stage (112° C. [234° F.]). (For description of test see p. 202.) At first, stir the mixture occasionally; toward the end, stir it more often to keep it from sticking to the pan.
3. As soon as the soft-ball stage has been reached, remove the syrup from the fire and set it aside to cool. Cool to 65° C. (149° F.)[8] or until the bottom of the pan feels quite warm but not uncomfortably hot.
4. Oil the molding pan with butter. Chop nut meats if they are to be added.
5. Beat the candy syrup until it loses its shiny, sticky appearance and becomes soft and creamy; quickly add the vanilla and nut meats; then continue the beating for a few seconds longer. At the first sign of stiffening, turn it quickly into the molding pan. If turned out at the right instant, it spreads slowly over the pan and stiffens almost immediately with a glossy, slightly roughened surface. If turned out too soon, while still soft and runny, it hardens slowly and is coarse and crystalline. On the other hand, if not turned out until it hardens, it must be kneaded before it can be molded and, as a result, has a dull and unattractive surface.
6. Cut the candy when it is cool. Keep it in a tin box tightly covered or in some other practically airtight container.

BROWN-SUGAR FUDGE

Yield

One and one-quarter pounds, or 25 pieces, $1\frac{1}{4}$ inches by 1 inch by $\frac{3}{4}$ inch.

Utensils

Cooking-pan: capacity, 3 quarts.

Molding pan: capacity, 1 quart. The one used in this laboratory is $6\frac{1}{2}$ inches by 5 inches by $1\frac{3}{4}$ inches.

[8] Fudge mixtures, with their large proportion of foreign material, need not be cooled below 65° C. for fine crystals.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Light-brown sugar.........	195	1 cup
Granulated sugar..........	200	1 cup
Coffee cream (18 per cent)..	239	½ pint
Nut meats, if desired (¼ pound).................	113	1 cup

Order of work

1. Weigh or measure the ingredients; mix them together in the cooking-pan.
2. Bring the syrup slowly to the boiling-point, stirring most of the time. Cook to the soft-ball stage (112° C. [234° F.]). (For description of test see p. 202.) Regulate the fire so that the cooking-period takes about 20 minutes. At first, stir the mixture occasionally; toward the end, stir it more often to keep it from sticking to the pan.
3. As soon as the soft-ball stage has been reached, remove the syrup from the fire and set it aside to cool. Cool to 65° C. (149° F.), or until the bottom of the pan feels quite warm but not uncomfortably hot.
4. Oil the molding pan with butter. Chop nut meats if they are to be used.
5. Beat the candy syrup until it loses its shiny, sticky appearance and becomes soft and creamy; quickly add the nut meats; then continue the beating for a few seconds longer. At the first sign of stiffening, turn it quickly into the molding pan. If turned out at the right instant, it spreads slowly over the pan and stiffens almost immediately with a glossy, slightly roughened surface. If turned out too soon, while still soft and runny, it hardens slowly and is coarse and crystalline. On the other hand, if not turned out until it hardens, it must be kneaded before it can be molded and, as a result, has a dull and unattractive surface.
6. Cut the candy when it is cool. Keep it in a tin box tightly covered or in some other practically airtight container.

PLAIN CARAMELS

Yield

One and one-fourth pounds, or 40 pieces, 1 inch by $\frac{3}{4}$ inch by $\frac{3}{4}$ inch.

Utensils

Cooking-pan: capacity, 3 quarts.

Molding pan: capacity, 1 quart. The one used in this laboratory is $6\frac{1}{2}$ inches by 5 inches by $1\frac{3}{4}$ inches.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Sugar	200	1 cup
Corn syrup	240	1 cup
Coffee cream (18 per cent)[9]	239	$\frac{1}{2}$ pint
Butter	53	$\frac{1}{4}$ cup
Nut meats, if desired ($\frac{1}{4}$ pound)	113	1 cup

Order of work

1. Oil the molding pan with butter. Chop nut meats if they are to be used.
2. Weigh or measure the ingredients; place them in the cooking-pan and mix them well.
3. Cook until a portion separates into strings which are hard but not brittle when poured into cold water (117° C. [242° F]). Stir occasionally at the beginning of the cooking-period, and constantly after the mixture begins to caramelize.
4. Add nut meats and turn into the molding pan. When entirely cold, remove from the pan, cut into pieces, and wrap each piece in *heavy* waxed paper. (Light-weight paper cannot be removed from caramels easily.)

CHOCOLATE CARAMELS

Follow the recipe for plain caramels with the following change:

1. Add 1 square of bitter chocolate, unmelted, to the hot candy mixture.

[9] One cup of evaporated milk may be substituted for the cream.

CHAPTER IX

ICE-CREAM

ALL types of ice-cream are crystalline products; and in them, as in candies, crystals of very small size are desired when the cream is served, whether that be shortly after it is made or several hours later. In candies the crystals are made up of sugar particles, in ice-cream they are simply frozen water or ice; nevertheless, the principle of making and keeping them small is the same for the two products. Both contain certain substances which, by acting as interference, keep sugar particles in one case, water particles in the other, from coming together freely to form large crystals, and prevent the growth of such crystals as do form.

The interfering substances in ice-cream are the fat and other milk solids, the sugar, and whatever else is added in the way of eggs, fruit, or whatnot—in fact, everything save water itself, of which there is about 60–70 per cent. The most effective interfering substances are those which increase the whipping property of the mixture and thus allow much air to be beaten into it. Beating air into an ice-cream mixture has the same effect as beating it into egg white. In the process many tiny air compartments are formed, each separated from its neighbor by a thin wall made up of water containing solids in solution and suspension. When freezing occurs, the water separates out in crystals which are small at first and stay small, apparently owing to the fact that they are protected from one another by the intervening solids and air cells.

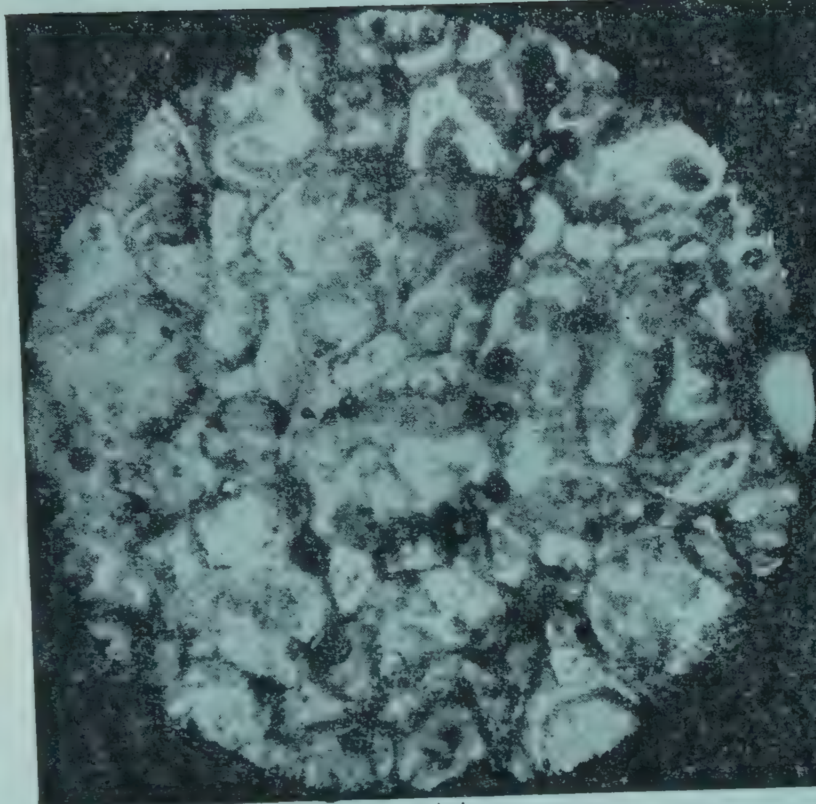
One way to obtain an ice-cream mixture which will hold air

is to use whipping cream. This makes the crystals small but, at the same time, gives the cream an unpleasant consistency manifested by a tendency to stick to the mouth. Other substances which are effective in increasing the whipping capacity are egg yolk and milk solids.

The juice of acid fruits, such as lemons and oranges, helps in making a fine-textured ice-cream and one which is pleasing in flavor. In adding such juices, special precaution must be taken to have the mixture cold, for otherwise the acid will cause the formation of hard curds, like those of cottage cheese, in place of the slight thickening desired. Gelatin, too, tends to improve the grain and also helps to prevent melting, but it should be used in very small quantities, for large ones give an undesirable sponginess and a disagreeable flavor.

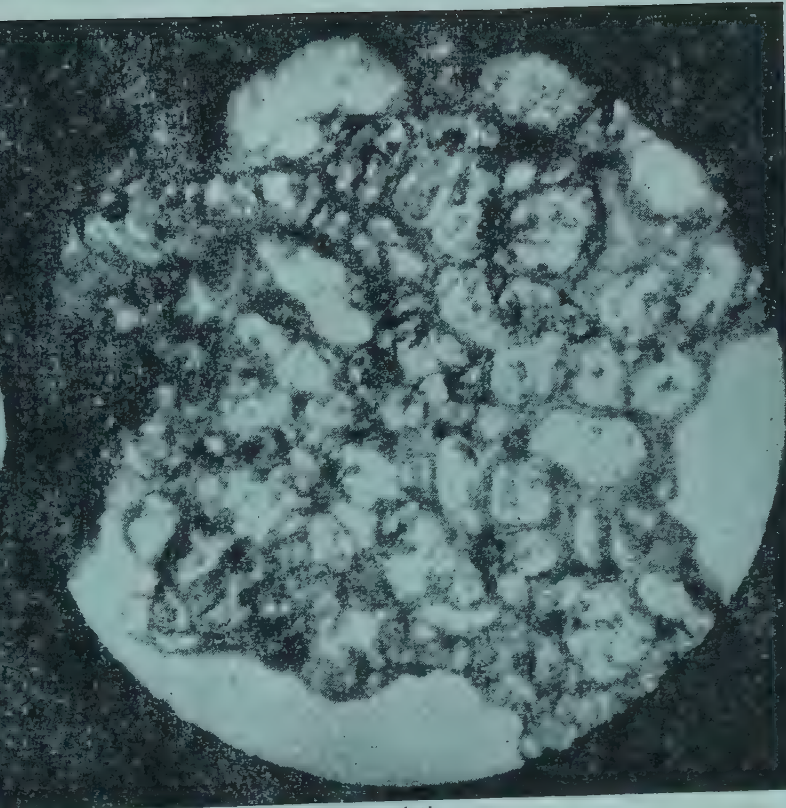
Still another way to improve texture is to homogenize the ice-cream mixture, that is, to subject it to such high pressure that each large particle of fat has been divided into something like a thousand smaller ones, all of which tend to act as interfering substances and thus make the ice crystals small. Such a practice is common in commercial ice-cream plants but, of course, cannot be resorted to in the home. Much the same effect can be produced, however, by using homogenized cream and milk, including evaporated milk.

Proof that three of the substances just mentioned—egg, gelatin, and evaporated (homogenized) milk—do really tend to make ice crystals small is given by the photomicrographs of Figures 70–73. These were kindly supplied by Meta Given, formerly director of the home economics service of the Evaporated Milk Association. Figure 70 shows the ice crystals formed in the control—an ice-cream made from milk, cream, and sugar only. Figures 71, 72, and 73 show the crystals in creams made by substituting egg, gelatin, or evaporated milk for part of the milk and cream used in the control (Fig. 70). Even a casual glance at these photomicrographs shows that the crystals of the ice-creams containing egg, gelatin, or evaporated milk are, on the



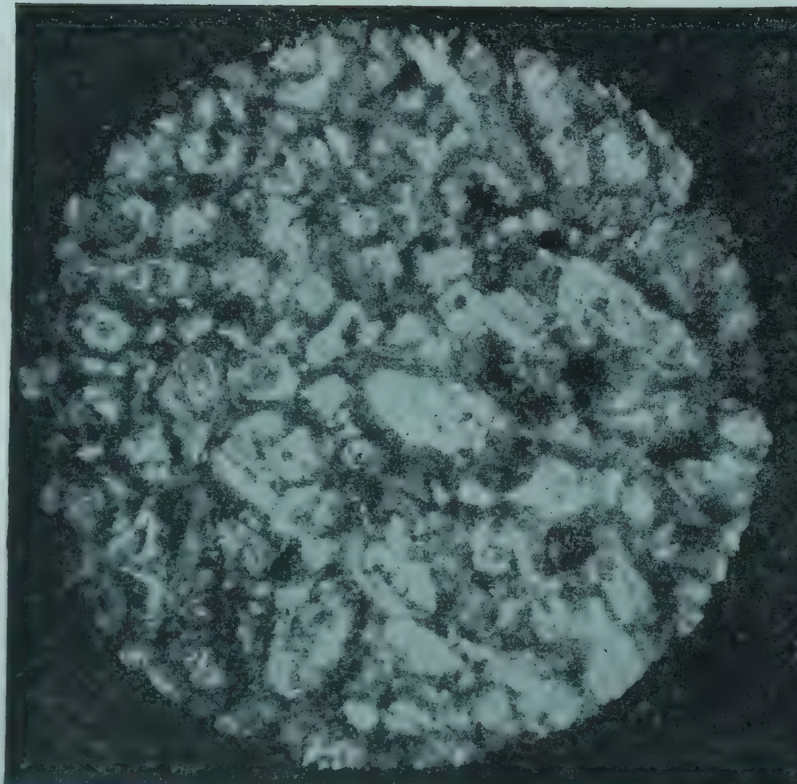
Courtesy of the Evaporated Milk Association

FIG. 70.—Crystals in ice-cream made from cream and milk. Large crystals like these make an ice-cream feel very rough rather than smooth and velvety to the tongue, and also make it appear "watery" rather than rich. Magnification approximately ×200.



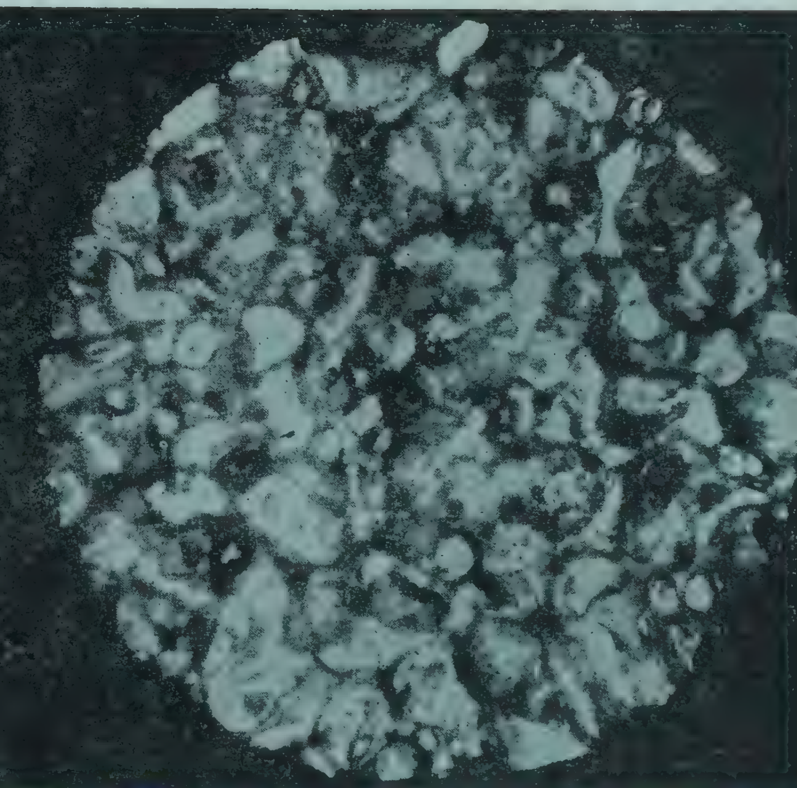
Courtesy of the Evaporated Milk Association

FIG. 71.—Crystals in ice-cream made from cream, milk, and *egg*. These crystals are smaller than those in Figure 70 and give to the ice-cream a more velvety texture. Magnification approximately ×200.



Courtesy of the Evaporated Milk Association

FIG. 72.—Crystals in ice-cream made from cream, milk, and *gelatin*. Magnification approximately ×200.



Courtesy of the Evaporated Milk Association

FIG. 73.—Crystals in ice-cream made from cream, milk, and *evaporated (homogenized) milk*. Magnification approximately ×200.

The crystals in these two figures, like those in Figure 71, are much smaller than the ones in Figure 70 and form a velvety ice-cream.

average, considerably smaller than are the crystals of the control.

The formulas for the four ice-creams are as follows:

The control (Fig. 70):

Sugar	14.0 per cent
Cream	32.0 per cent
Milk	54.0 per cent
	100.0 per cent

The ice-cream containing *egg* (Fig. 71):

Sugar	14.0 per cent
Cream	31.0 per cent
Milk	52.5 per cent
Egg	2.5 per cent
	100.0 per cent

The ice-cream containing *gelatin* (Fig. 72):

Sugar	14.0 per cent
Cream	32.0 per cent
Milk	53.7 per cent
Gelatin	0.3 per cent
	100.0 per cent

The ice-cream containing *evaporated* (*homogenized*) *milk* (Fig. 73):

Sugar	14.0 per cent
Cream	28.0 per cent
Milk	36.0 per cent
Evaporated milk	22.0 per cent
	100.0 per cent

In freezer ice-creams, the amount of air incorporated is dependent, for any given mixture, upon the speed of turning the freezer and upon the temperature of the surrounding bath. The

latter, in turn, is largely determined by the proportion of salt to ice. If much salt is used—say, one part to three or four of ice by measure—the temperature runs down rapidly, and, as a consequence, the time through which the freezer can be turned is short. Therefore, it is difficult to turn a freezer by hand fast enough to incorporate sufficient air for a fine-textured ice-cream. We have had very good results by using one part of salt to six of ice by weight, which by measure is about one to twelve, or 1 cup of salt to each 3 quarts of chopped ice.

In mechanical refrigerator ice-creams, continuous beating during freezing is not possible; hence, if much air is to be incorporated, whipping cream, egg whites, and perhaps custard must be used and the mixture beaten before freezing is begun—in other words, mousses or parfaits must be made. Since these are richer than most people prefer for everyday use, we have sought to work out directions for making less rich fruit-juice creams in which a certain amount of air can be incorporated by beating before freezing has begun. These creams we consider good when served soon after freezing; but, if allowed to stand overnight or longer, they tend to develop large crystals.

DIRECTIONS FOR THE PREPARATION OF FREEZER ICE-CREAMS[1]

Yield for each recipe

Eleven servings of $\frac{1}{2}$ cup each.

Utensils

A 2-quart ice-cream freezer which has a beater. (For method of putting the parts together see the booklet of instructions that accompanies the freezer.)

A burlap ice bag about 16 inches square, and a mallet with a head at least 6 inches long and a handle 9–10 inches long; or an ice chipper.

[1] Measurement of the ingredients used in ice-cream will give proportions sufficiently accurate for home cooking.

Ice and salt

For freezing and packing.—Ten to 11 pounds (8 to 9 quarts) of chopped ice and about $\frac{1}{2}$ pound ($2\frac{1}{3}$ to $2\frac{2}{3}$ cups) of ice-cream salt are the minimum quantities required to freeze and pack (once) a 2-quart freezer of ice-cream on a cool day, about 75° F., when there are no delays between the time the ice is chopped and the cream packed.

For freezing only.—About 5 pounds (4 quarts) of ice and $1\frac{1}{3}$ cups of salt will be necessary to freeze the ice-cream. This amount of ice may be obtained from a mechanical refrigerator whose freezing-pans hold $2\frac{1}{2}$ quarts of water, and the packing may be done in the freezing-pans.

VANILLA ICE-CREAM (WITH EGG)

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Egg	96	2 medium sized
Sugar	100	$\frac{1}{2}$ cup
Milk	305	$1\frac{1}{4}$ cups
Coffee cream (18 per cent)	598	$2\frac{1}{2}$ cups
Vanilla	...	2 teaspoons
Salt	...	$\frac{1}{2}$ teaspoon

Order of work: Detailed form

1. Pour boiling water over the cream can and the beater of the freezer; drain them and set them aside to cool.

   Select a cork which fits the opening in the top of the can, if a tight packing-cover is not available.
2. From the egg, sugar, and milk prepare a custard as follows:
   a) Beat the eggs until the yolks and whites are well mixed. Weigh or measure the sugar and milk. Stir them with the egg. Transfer to the top of a double boiler.
   b) Cook the mixture in the double boiler, stirring constantly, until it thickens enough to coat a metal spoon

with a thin layer that will not drain off (about 4 minutes). Then set it in a pan of cold water.

The custard is very thin, being but slightly thicker than coffee cream. Care should be taken to avoid overcooking it, for heating a little too long will cause the formation of small curds which can be detected in the finished ice-cream.

3. While the custard is cooling, place near the freezer a large pan in which the ice and salt can be mixed, also a quart measure and a cup in which the ice and salt, respectively, can be measured. Lastly, crush the ice into small pieces.
4. Mix the cream, vanilla, and salt with the cooled custard; then pour this mixture into the cream can of the freezer and fit the dasher, lid, can, and crank into place.

   If the parts are fitted together correctly, the crank will turn freely, and the dasher as well as the cream can will revolve when the crank is turned.
5. Freeze the ice-cream as follows:
   a) Measure 4 quarts of the chopped ice; add $1\frac{1}{3}$ cups of the salt. Mix the two, and quickly pack them into the ice chamber of the freezer.

   b) Turn the crank slowly[2] for about 3 minutes, then as quickly as possible until it is very difficult to turn (about 6 minutes more).

   If the finished ice-cream is to be at its best, the turning must be continuous.

   c) Clear away the salt and ice to about 1 inch below the bottom of the lid of the cream can and wipe the lid carefully to remove the brine. Open the can, and, if the ice-cream is frozen almost but not quite solid enough to serve, pack it either in the ice-cream freezer or in the freezing-pans of a mechanical refrigerator.

   To pack in the freezer, remove the beater, push the ice-cream into the bottom of the can, replace the lid of the

[2] "Slow" turning means about 40 revolutions per minute; "fast" turning about 140 revolutions per minute at first and 80 at last, when the cream is almost frozen.

can and fit it with the cork or packing-cover to prevent the brine from entering through the hole. Drain most of the water from the ice chamber. Mix together 3 quarts of chopped ice and 1 cup of ice-cream salt and pack them into the freezer and over the top of the can. Cover the freezer with paper and a damp cloth. Set it in the coolest place available until ready to serve. At the end of each hour or so thereafter, examine the ice chamber and, if necessary, drain and repack with a fresh ice-salt mixture.

To pack in a mechanical refrigerator, remove the beater, and then transfer the ice-cream so quickly from the ice-cream can to the cold, dry freezing-pans that it does not melt. For the amount of ice-cream frozen in a 2-quart freezer, pans with a total capacity of about 8 cups will be necessary.

Order of work: Abbreviated form

1. Proportion of ingredients:

Egg	2 medium sized
Sugar	$\frac{1}{2}$ cup
Milk	$1\frac{1}{4}$ cups
Coffee cream (18 per cent)	$2\frac{1}{2}$ cups
Vanilla	2 teaspoons
Salt	$\frac{1}{2}$ teaspoon

2. Mix together the beaten egg, sugar, and milk. Cook them in a double boiler until they form a coating on a metal spoon. When cool, mix them with the cream, vanilla, and salt and turn them into the cream can of the freezer.
3. Fit the parts of the freezer together.
4. Pack the ice chamber (4 quarts of ice plus $1\frac{1}{3}$ cups of salt).
5. Turn the crank slowly for 3 minutes, then rapidly until it becomes very difficult to turn (about 6 minutes).
6. Remove the beater. Pack the ice chamber (3 quarts ice plus 1 cup salt), or quickly transfer the ice-cream to the freezing unit of a mechanical refrigerator.

VANILLA ICE-CREAM (WITH GELATIN)

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Gelatin	5.0	$1\frac{3}{4}$ teaspoons ($\frac{3}{4}$ envelope)
Cold water	.....	1 tablespoon
Boiling water	.....	1 tablespoon
Milk	305	$1\frac{1}{4}$ cups
Sugar	100	$\frac{1}{2}$ cup
Coffee cream (18 per cent)	598	$2\frac{1}{2}$ cups
Salt	.....	$\frac{1}{2}$ teaspoon
Vanilla	.....	2 teaspoons

Order of work

1. Pour boiling water over the cream can and the beater of the freezer; drain them and set them aside to cool.

   Select a cork which fits the opening in the top of the can, if a tight packing-cover is not available.
2. Dissolve the gelatin and sugar as follows:
   a) Weigh or measure the gelatin. Mix the cold water with it and let the two stand for about 5 minutes.
   b) Weigh or measure the milk and sugar. Mix them, then heat over hot water.
   c) Add the boiling water to the gelatin and stir the two together over hot water until all of the gelatin is dissolved. (Granules of undissolved gelatin can be detected in the finished ice-cream.)

   Add the gelatin to the warm milk-sugar mixture and continue heating until all the sugar and gelatin are dissolved, then cool.
3. While the milk-gelatin-sugar mixture is cooling, place near the freezer a large pan in which the ice and salt can be mixed; a quart measure and a cup in which the ice and salt, respectively, can be measured. Lastly, crush the ice into small pieces.

4. Mix the cream, vanilla, and salt with the cooled milk-gelatin-sugar combination; then pour this mixture into the cream can of the freezer and fit the dasher, lid, can, and crank into place.

   If the parts are fitted together correctly, the crank will turn freely, and the dasher as well as the cream can will revolve when the crank is turned.

5. Freeze the ice-cream as follows:

   a) Measure 4 quarts of the chopped ice; add $1\frac{1}{3}$ cups of the salt. Mix the two and quickly pack them into the ice chamber of the freezer.

   b) Turn the crank slowly[3] for about 3 minutes, then as quickly as possible until it is very difficult to turn (about 6 minutes more).

   If the finished ice-cream is to be at its best, the turning must be continuous.

   c) Clear away the salt and ice to about 1 inch below the bottom of the lid of the cream can and wipe the lid carefully to remove the brine. Open the can, and, if the ice-cream is frozen almost but not quite solid enough to serve, pack it either in the ice-cream freezer or in the freezing-pans of an electric refrigerator.

   To pack in the freezer, remove the beater, push the ice-cream into the bottom of the can, replace the lid of the can and fit it with the cork or packing-cover to prevent the brine from entering through the hole. Drain most of the water from the ice chamber. Mix together 3 quarts of chopped ice and 1 cup of ice-cream salt and pack them into the freezer and over the top of the can. Cover the freezer with paper and a damp cloth. Set it in the coolest place available until ready to serve. At the end of each hour or so thereafter, examine the ice chamber and, if necessary, drain and repack with a fresh ice-salt mixture.

   To pack in a mechanical refrigerator, remove the

[3] See p. 228, n. 2.

beater and then transfer the ice-cream so quickly from the ice-cream can to the cold, dry freezing-pans that it does not melt. For the amount of ice-cream frozen in a 2-quart freezer, pans with a total capacity of about 8 cups will be necessary.

STRAWBERRY ICE-CREAM

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Fresh strawberry juice	390	1½ cups (the juice from about 1 quart of fresh, ripe berries)
Lemon juice	15	1 tablespoon (juice from about ½ lemon)
Milk	183	¾ cup
Sugar	200 to 300	1 to 1½ cups
Coffee cream (18 per cent)[4]	359	1½ cups
Salt	...	¼ teaspoon

Order of work

1. Pour boiling water over the cream can and the beater of the freezer; drain them and set them aside to cool.

   Select a cork which fits the opening in the top of the can, if a tight packing-cover is not available.

2. Wash and stem the berries. Mash them to a pulp with a potato-masher. Press as much of the juice and pulp through a coarse sieve as will go without carrying seeds with it.

   Weigh or measure from this juice the amount needed, add the lemon juice to it, and set the mixture in a cool place.

[4] Evaporated milk may be substituted for the cream.

3. Weigh or measure the milk and sugar. Mix the two and heat them over hot water until the sugar is dissolved. Then cool.
4. While the sugar-milk mixture is cooling, place near the freezer a large pan in which the ice and salt can be mixed, a quart measure and a cup in which the ice and salt, respectively, can be measured. Lastly, crush the ice into small pieces.
5. Mix the cream and salt with the cool milk-sugar solution; turn this mixture into the cream can of the freezer and fit the beater, lid, can, and crank into place.

   If the parts are fitted together correctly, the crank will turn freely, and the beater as well as the cream can will revolve when the crank is turned.
6. Freeze the ice-cream as follows:
   a) Measure 4 quarts of the chopped ice; add $1\frac{1}{3}$ cups of the salt. Mix the two, and quickly pack them into the ice chamber of the freezer.
   b) Turn the crank slowly[5] until the mixture is frozen to a soft mush (for about 7 minutes).
   c) Clear away the salt and ice to about 1 inch below the bottom of the lid of the cream can and wipe the lid carefully to remove the brine.
   d) Open the can and mix the strawberry and lemon juice with the cream; then, as quickly as possible, replace the parts of the freezer, mix another quart of the ice with $\frac{1}{3}$ cup of the salt, pack into the ice chamber, and start turning the crank.
   e) Turn the crank slowly for about 1 minute, then as rapidly as possible until it becomes very difficult to turn (about 6 minutes more).

   If the finished ice-cream is to be at its best, the turning must be continuous except for the short break during the addition of the fruit juice, which should not take longer than about 2 minutes.

[5] See p. 228, n. 2.

f) Open the cream can, taking the same precautions as above to prevent brine from entering it; and, if the ice-cream is frozen almost but not quite solid enough to serve, pack it either in the ice-cream freezer or in the freezing-pans of a mechanical refrigerator.

To pack in the freezer, remove the beater, push the ice-cream into the bottom of the can, replace the lid of the can, and fit it with the cork or the packing-cover to prevent the brine from entering through the hole. Drain most of the water from the ice chamber. Mix together 3 quarts of chopped ice and 1 cup of ice-cream salt and pack them into the freezer and over the top of the can. Cover the freezer with paper and a damp cloth. Set it in the coolest place available until ready to serve. At the end of each hour or so thereafter, examine the ice chamber and, if necessary, drain and repack with a fresh ice-salt mixture.

To pack in a mechanical refrigerator, remove the beater and then transfer the ice-cream so quickly from the ice-cream can to the cold, dry freezing-pans that it does not melt. For the amount of ice-cream frozen in a 2-quart freezer, pans with a total capacity of about 8 cups will be necessary.

ORANGE OR LEMON ICE-CREAM

Proportion of ingredients for orange ice-cream

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Orange juice	367	$1\frac{1}{2}$ cups (juice from about 4 juicy oranges)
Lemon juice	61	$\frac{1}{4}$ cup (juice from about 2 lemons)
Milk	183	$\frac{3}{4}$ cup
Sugar	250	$1\frac{1}{4}$ cups
Coffee cream (18 per cent)	359	$1\frac{1}{2}$ cups
Salt	...	$\frac{1}{4}$ teaspoon

Proportion of ingredients for lemon ice-cream

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Lemon juice	120 to 160	$\frac{1}{2}$ to $\frac{2}{3}$ cup (juice from about 4 lemons)
Milk	488	2 cups
Sugar	300	$1\frac{1}{2}$ cups
Coffee cream (18 per cent)	359	$1\frac{1}{2}$ cups
Salt	...	$\frac{1}{4}$ teaspoon

Order of work

1. Pour boiling water over the cream can and the beater of the freezer; drain them and set them aside to cool.

   Select a cork which fits the opening in the top of the can, if a tight packing-cover is not available.
2. Squeeze out the fruit juice. Strain through a coarse sieve, then weigh or measure, mix if two are used, and set aside in a cool place.
3. Weigh or measure the milk and sugar. Mix the two and heat them over hot water until the sugar is dissolved, then cool.
4. While the sugar-milk mixture is cooling, place near the freezer a large pan in which the ice and salt can be mixed, a quart measure, and a cup in which the ice and salt, respectively, can be measured. Lastly, crush the ice into small pieces.
5. Mix the cream and salt with the cool milk-sugar solution; turn this mixture into the cream can of the freezer; and fit the beater, lid, can, and crank into place.

   If the parts are fitted together correctly, the crank will turn freely and the beater as well as the cream can will revolve when the crank is turned.
6. Freeze the ice-cream as follows:

   a) Measure 4 quarts of the chopped ice; add $1\frac{1}{3}$ cups of the salt. Mix the two and quickly pack them into the ice chamber of the freezer.

b) Turn the crank slowly[6] until the mixture is frozen to a soft mush (for about 7 minutes).

c) Clear away the salt and ice to about 1 inch below the bottom of the lid of the cream can and wipe the lid carefully to remove the brine.

d) Open the can and mix the fruit juice with the cream; then, as quickly as possible, replace the parts of the freezer, mix another quart of ice with $\frac{1}{3}$ cup salt, pack into the ice chamber, and start turning the crank.

e) Turn the crank slowly for about 1 minute, then as rapidly as possible until it becomes very difficult to turn (about 6 minutes more).

If the finished ice-cream is to be at its best, the turning must be continuous except for the short break during the addition of the fruit juice, which should not take longer than about 2 minutes.

f) Open the cream can, taking the same precautions as above to prevent brine from entering it, and, if the ice-cream is frozen almost but not quite solid enough to serve, pack it either in the ice-cream freezer or in the freezing-pans of a mechanical refrigerator.

To pack in the freezer, remove the beater, push the ice-cream into the bottom of the can, replace the lid of the can, and fit it with the cork or the packing-cover to prevent the brine from entering through the hole. Drain most of the water from the ice-chamber. Mix together 3 quarts of chopped ice and 1 cup of ice-cream salt and pack them into the freezer and over the top of the can. Cover the freezer with paper and a damp cloth. Set it in the coolest place available until ready to serve. At the end of each hour or so thereafter, examine the ice-chamber and, if necessary, drain and repack with a fresh ice-salt mixture.

[6] See p. 228, n. 2.

To pack in a mechanical refrigerator, remove the beater and then transfer the ice-cream so quickly from the ice-cream can to the cold, dry freezing-pans that it does not melt. For the amount of ice-cream frozen in a 2-quart freezer, pans with a total capacity of about 8 cups will be necessary.

DIRECTIONS FOR THE PREPARATION OF REFRIGERATOR ICE-CREAMS

STRAWBERRY ICE-CREAM

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Strawberry[7] juice		
Fresh	390	1½ cups (the juice from about 1 quart of ripe berries)
Frozen	300	1¼ cups (the juice from 1 pound of frozen berries)
Lemon juice	45	3 tablespoons (juice from about 1½ lemons)
Sugar		
For fresh berries	200 to 300	1 to 1½ cups
For frozen berries	67	⅓ cup
Salt	.....	¼ teaspoon
Coffee cream	240	1 cup
Whipping cream	232	1 cup
Gelatin	3.7	1¼ teaspoon (½ envelope)

[7] Raspberry or other berry juice, fresh or frozen, may be used in place of strawberry juice.

Order of work

1. Weigh or measure the gelatin, place it in a 2 3-quart bowl, add about $\frac{1}{4}$ cup of the coffee cream, and let stand about 5 minutes.
2. Heat the remainder of the coffee cream ($\frac{3}{4}$ cup) and add to the gelatin. Stir the mixture well and, if the gelatin does not completely dissolve, heat over hot water. Add the sugar and salt and stir until the sugar is dissolved.
3. Put the strawberries through a sieve in such a way that much of the pulp is obtained. Add the lemon juice.
4. Combine the gelatin mixture with the fruit juice. Beat the combination with a rotary beater for 1 or 2 minutes.
5. Whip the whipping cream and add it to the other ingredients. Beat the mixture for a few seconds, then turn it into a flat-bottomed metal dish, a 2-quart basin, or the ice-cube refrigerator pans; and place it in the freezing compartment of a mechanical refrigerator and let stand until it begins to freeze, which should be in about 45 minutes. Remove the partially frozen mixture from the refrigerator and beat for about a minute with a wire egg-whip, then replace it in the freezing compartment and leave it there until it freezes, which should be in about 2 hours.

LEMON ICE-CREAM

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Lemon juice	160	$\frac{2}{3}$ cup (juice from 5 or 6 lemons)
Sugar	267	$1\frac{1}{3}$ cups
Salt	.....	$\frac{1}{4}$ teaspoon
Milk	488	2 cups
Whipping cream	232	1 cup
Gelatin	3.7	$1\frac{1}{4}$ teaspoon ($\frac{1}{2}$ envelope)

Order of work

1. Weigh or measure the gelatin, place it in a 2–3-quart bowl, add about $\frac{1}{4}$ cup of the milk and let stand for 5–10 minutes.
2. Heat about $\frac{3}{4}$ cup of the milk and add to the gelatin. Stir the mixture well and, if the gelatin does not completely dissolve, heat over hot water. Add the remainder of the milk (1 cup) and the sugar and salt. Stir the mixture until the sugar is dissolved.
3. Squeeze the lemon juice and combine it with the gelatin mixture. Beat the combination with a rotary beater for 1 or 2 minutes.
4. Whip the whipping cream and add it to the other ingredients. Beat the mixture for a few seconds, then turn it into a flat-bottomed metal dish, a 2-quart basin, or the ice-cube refrigerator pans; and place it in the freezing compartment of a mechanical refrigerator and let stand until it begins to freeze, which should be in about 45 minutes. Remove the partially frozen mixture from the refrigerator and beat for about a minute with a wire egg-whip, then replace it in the freezing compartment and leave it there until it freezes, which should be in about 2 hours.

CHAPTER X

BEEF

THE variation in the price of beef available to the city consumer depends, first, on the grade of the animal from which the meat comes and, second, upon the location in that animal—in other words, upon the "cut." Just how wide a variation to expect with these two factors is evident to anyone who scans the market reports in the daily papers, where the price per hundred, live weight, is given for all grades and classes of beef animals. As one might expect, the actual prices change from time to time; but the order is always the same—choice to prime steers highest, cutter and canner cows lowest. An illustration of the way the price picture may change from one time to another is shown by the data for the Chicago market given in Table 14 for 1939 and 1946. For example, choice steers sold for $12.35 per hundredweight on January 28, 1939, whereas on January 26, 1946, they went as high as $17.70.

Typical examples of the possible variation in the cost per pound of the different parts of a beef animal are shown by the quotations in the accompanying tabulation for wholesale cuts of choice animals on the Chicago market in 1932, 1939, and 1946.

Cut	Cents per Pound			Cut	Cents per Pound		
	1932	1939	1946		1932	1939	1946
Loins	29	33	32.8	Rounds	15.5	17	22.5
Ribs	21	26	24.5	Chucks	9.5	15	20.5

Here again it may be noted that, while the actual prices may change from one period to another, the order remains the same, with loins and ribs selling for more than rounds and chucks.

With beef of all prices to choose from, the household buyer who knows little about meat is often completely bewildered. If she is one of small means who must of necessity make the best

TABLE 14

PRICE RANGE IN BEEF ANIMALS OF DIFFERENT GRADE

(Average Values for One Week in Chicago)

Classification	Per Hundred Live Weight	
	January 28, 1939	January 26, 1946
Steers:		
Choice	$12.35	$17.70
Good	10.55	16.70
Medium	8.50	14.25
Common	7.62	11.50
Heifers:		
Choice	11.12	17.40
Good	9.75	16.12
Medium	8.65	13.42
Common	7.45	10.48
Cows:		
Good	7.10	14.12
Medium	6.55	12.82
Common	5.44	9.90
Canner	4.94	7.32

use of her money, she is more than likely to be a dissatisfied customer who shops around from one meat market to another, thinking that the prices charged are largely dependent upon the will of the retailer rather than upon the quality of his stock. She calls for a "good" steak or a "good" roast without specifying the kind and is pained and surprised if she pays twice as much in one shop as in another for what she considers to be practically the same thing. Thus her "good" steak might be interpreted to mean a porterhouse from a "choice" steer by one dealer, where-

as by another it might be taken to mean the top of the round from a "medium" cow; and both retailers would have been right, for both steaks are "good" if properly cooked. In order that the customer may make an intelligent choice and be satisfied with her purchase she needs to know the relative merits, availability, and distinguishing features of different grades and cuts of meat. The first step in the acquisition of such knowledge is to learn what properties are considered in fixing the grade of beef.

FACTORS CONSIDERED IN GRADING BEEF

Since the time of the fatted calf, which introduced discord into the Prodigal Son's family, certain properties of animals, including age and fatness, have been known, or thought, to contribute toward the eating qualities and have been considered in fixing the market price of animals and of the meat obtained from them. In a sense, then, there has always been a system of sorts for grading meat. It is only within the present century, however, that the government and the packers have developed systematic methods of grading. According to these systems the various properties considered are grouped under three headings: conformation, finish, and quality. The exact specifications called for under each differ somewhat with the sex-condition, age, and weight of the animals being judged but are nearly enough alike to justify the general statements given in the discussion which follows.

"Conformation" refers to the form or the shape of the carcass, which, in turn, depends on the form or shape of the animal. The ideal beef animal is thick set and compact and has, therefore, less bone and more flesh, particularly in the loins, ribs, and rounds, than has the angular type, sometimes designated as "rangy." This is a decided advantage to both the meat-dealer and the consumer in that there is a greater proportion of the more highly prized parts. Conformation, of course, can be determined from the appearance of live animals and is one of the factors considered in grading them. The two steers shown in Figures 74 and 75 illustrate the difference which may exist be-

Fig. 74.—A grand champion steer, International Livestock Exposition. This steer is ideal in conformation and finish. Note the short legs and neck, and the thick loin and round.

Courtesy of the U.S. Department of Agriculture

Fig. 75.—A canner steer. This steer is extremely low in conformation and finish. Note the long legs and neck, and the thin loin and round.

tween an animal of ideal conformation and one which is inferior in that respect.

"Finish" refers to the amount and distribution of the fat. To grade high a carcass must have a smooth, even covering of firm white fat over its exterior surface, a layer of fat on the interior of the ribs, and heavy but not wasty deposits of fat over the kidneys. One which falls short in any one of these respects loses grade points, and one which falls short in all respects is at the bottom of the list. Thus a carcass with almost no fat on its outer surface and with such fat as it has elsewhere distributed in bunches is the lowest of all with respect to finish.

There seems to be ample justification for the high value placed on the properties called for under ideal finish. A good layer of fat protects the flesh from the action of microörganisms during the ripening period necessary for the development of tenderness and flavor, and it prevents undue loss of moisture and volatile flavoring during cooking. Firmness and color are also important, as will be discussed presently under "quality."

"Quality" in beef refers to the color and character of the fat, flesh, and bone—particularly the chine or backbone, which is exposed when the carcass is split. To measure up to the highest standards, the fat must be firm, with no tendency to be oily, and it must be white or creamy white. An oily fat contains a high percentage of the easily oxidized unsaturated fatty acids, hence shows a greater tendency to become rancid during storage than does a firm one. If the fat is white, the chances are that the animal was young and well fed and therefore, presumably, that its flesh will be tender and well flavored. A markedly yellow fat, on the other hand, indicates a poorly finished animal, perhaps an old one of the dairy type whose flesh will be of inferior quality.

In beef of the highest quality, the lean must become bright cherry-red shortly after the surface is exposed to the air as it is when the carcass is cut into forequarters and hindquarters. This change is brought about by the oxygen of the air, which

transforms the dull-red hemoglobin to the bright-red oxyhemoglobin. Flesh from inferior animals, especially from old ones, does not thus brighten; therefore, the flesh of any animal which fails to do so loses grade points for color. This discrimination may not be entirely just, for the flesh of some young animals of excellent eating quality has been found to remain dark after cutting.

In addition to color, texture and marbling are two properties of major importance in the grading system. To grade high the flesh should be firm, yet smooth to the touch and have a certain sheen. Furthermore, it should hold its shape and have no tendency to slump or to look watery. Firmness is a property common to the muscles of young, well-conditioned animals, just as flabbiness is to those of old and poorly nourished ones; therefore, this value rates high. Smoothness is supposedly due to the presence of small muscle fibers and the absence of coarse connective tissue, hence is indicative of tenderness.

Well-marbled meat is that in which there is a liberal deposit of fat throughout the lean, either as little spots or as a delicate network. The latter should not be confused with the heavy, almost fat-free, connective tissue which is largely responsible for the lack of tenderness of certain cuts of meat from inferior animals. Beef which is marbled is better flavored and more juicy than that which is not. The fat deposited, like that of the surface covering, presumably holds in solution certain pleasant flavors from the feed, and it also tends to prevent loss of volatile flavorings and moisture from the lean during cooking. Satisfactory marbling is usually found in the lean of carcasses which have a satisfactory outer layer of fat.

In young animals the chine or backbone is soft and has a reddish tinge; in old ones this bone is hard and white, hence the character of the bone is considered an important factor in the grading system.

Although some of the properties included under the term "quality" cannot be determined with certainty until after the

carcass is cut into forequarters and hindquarters, nevertheless animals graded high for conformation and finish, as indicated from the appearance of the live animal, usually yield carcasses which grade high for quality. In other words, a compact animal of the beef type which is young and well fattened almost invariably yields high-quality meat. This fact accounts for the wide variation, already referred to, shown in the market price of animals. If the buyer could not predict with some degree of certainty from their appearance the quality of the meat to be obtained from live animals, he could make no price discrimination among them.

TABLE 15

GRADING SYSTEMS FOR BEEF

United States Department of Agriculture	American Meat Institute (Used by the Packers)	O.P.A.
Prime	0 (Prime)	(Choice) AA
Choice	1 (Choice) 2 (Good)	
Good	3 (Good medium)	(Good) A
Commercial	4 (Medium) 5 (Fair)	(Commercial) B
Utility	6 (Plain) 7 (Common)	(Utility) C
Cutter Canner	8 (Cutter) 9 (Canner)	(Cutter and canner) D

On the basis of conformation, finish, and quality, beef is divided into seven grades by the United States Department of Agriculture system and into ten by the system recommended by the American Meat Institute and followed by the various packing companies. In addition, as a wartime measure, the Office of Price Administration (O.P.A.) used a system much the same as that of the Department of Agriculture. The similarity and difference among these three systems can best be shown graphically by placing the terms used in the three, side by side, as in Table 15.

PROPERTIES AND DISTRIBUTION OF GRADES OF BEEF

The discussion which follows is based on the government grading system. The properties considered under each grade and the distribution thus differ somewhat from those of the packers' system with its ten in place of seven grades.

"Prime" beef is that which is practically perfect in conformation, finish, and quality. It is sometimes spoken of as the "exhibit"[1] of the meat trade and is almost entirely derived from steers that have been prepared for show purposes; hence there is little or none of it, save after the various state fairs and livestock expositions, which are held during the fall and winter months. Of the total beef supply in this country, probably considerably less than 1 per cent rates prime; therefore, as might be expected, this grade commands the top price.

"Choice," the grade immediately below prime, is so nearly the same in all respects that it is doubtful if the household buyer could detect the slightest difference in the appearance before cooking or in the tenderness and flavor after cooking of similar samples of the two grades. Choice beef is mostly from steers, though some is from heifers and occasionally some from well-fattened cows.

Beef graded "good" is very good indeed. Again it is doubtful if the household buyer could distinguish between similar pieces of good and choice. The little imperfections which the expert grader finds that prevent good beef from being graded as choice are really of little moment to the ordinary consumer.

"Commercial" beef is medium in grade and was so designated until recently. This grade falls somewhat short in practically all the values listed under conformation, finish, and quality. There is a rather large proportion of bone to flesh and a low proportion of fat, both as to that in the outer covering and as to that distributed as "marbling." Such fat as there is may be slightly yellow and inclined to be soft. The flesh has a tendency to be softer and not so bright in color as the higher grades of

[1] W. C. Davis and C. V. Whalin, *Market Classes and Grades of Dressed Beef* (U.S. Department of Agriculture Bull. 1246).

beef. It is probable that almost anyone would be able to detect a marked difference in the appearance and tenderness of commercial and choice beef if similar cuts of the two were inspected before cooking and tasted afterward.

"Utility" beef, formerly called "common," is normally the lowest grade sold in carcass form and is mostly obtained from dairy cows. It is markedly deficient in all the qualities listed under conformation, finish, and quality. Meat of this grade is found in shops which serve the poorer class of customers and in those which seek to serve all kinds, from the most well-to-do to the poorest.

The "cutter" grade of meat, as the name implies, is that which is cut up in the packing plant and sold by the piece or cut, rather than by the quarter or side. Some of the pieces, notably the ribs and loins, are found on the retail market, but most of it is used for canning, for sausage, and for dried beef.

The "canner" grade, again as one might know from the name, is mostly used for canning and for sausage. This grade, like the cutter, is made up largely of cows. The amount of cutter and canner meat on the market is so low that these grades are seldom met with by the household buyer.

At this point it may be well to call attention to a fact self-evident from the previous discussion, which is that appearance and supposed eating quality are the chief criteria of the grading system and that nutritive value is not even considered. If it were, the system might be more or less reversed, and some of the lower grades come to the top; for these, per unit of weight, have the higher protein content, and protein is, after all, one of the most important nutrients of meat.

The distribution by grade of steers on the Chicago market for a number of years, beginning with 1939 and ending with 1945, are given in Table 16, and the distribution of all beef officially graded for 1944 and 1945 in Table 17.

As can be seen, there was a decided drop in the percentage of choice beef during 1944, both for steers on the Chicago market, and for all beef graded in the United States. This was because

of the necessity during the war to produce a maximum amount of beef for the armed forces, our fighting allies, and for civilian consumption with a minimum of feed and grain.

INSPECTING, GRADING, BRANDING, AND STAMPING OF BEEF

Before attempting to tell how grading is carried out by the various agencies under their respective systems, a few words are in order about government inspection of meat. This service, commonly designated as "federal inspection," is sometimes confused with government grading, although the two have no con-

TABLE 16*

PERCENTAGE BY GRADE OF STEERS SOLD FOR SLAUGHTER AT CHICAGO IN 1939–1945

Grade	1939	1940	1941	1942	1943	1944	1945
Prime and choice	28.4	26.7	30.8	22.1	27.9	16.8	36.0
Good	46.6	45.6	44.7	51.3	49.4	56.4	46.2
Commercial	21.4	24.0	22.2	24.8	20.7	22.3	15.8
Utility	3.6	3.7	2.3	1.8	2.0	4.5	2.0

* Source: Livestock Branch, Production and Marketing Administration, U.S. Department of Agriculture.

TABLE 17*

PERCENTAGE BY GRADE OF ALL BEEF OFFICIALLY GRADED IN THE UNITED STATES DURING THE CALENDAR YEARS, 1944 AND 1945

Grade	1944		1945	
	January through June (Per Cent)	July through December (Per Cent)	January through June (Per Cent)	July through December (Per Cent)
Choice	15	6	16	12
Good	37	20	36	23
Commercial	22	28	24	28
Utility	13	24	14	20
Cutter and canner	13	22	10	17

* Estimate made by American Meat Institute from data supplied by Live Stock Branch Production and Marketing Administration, U.S. Department of Agriculture.

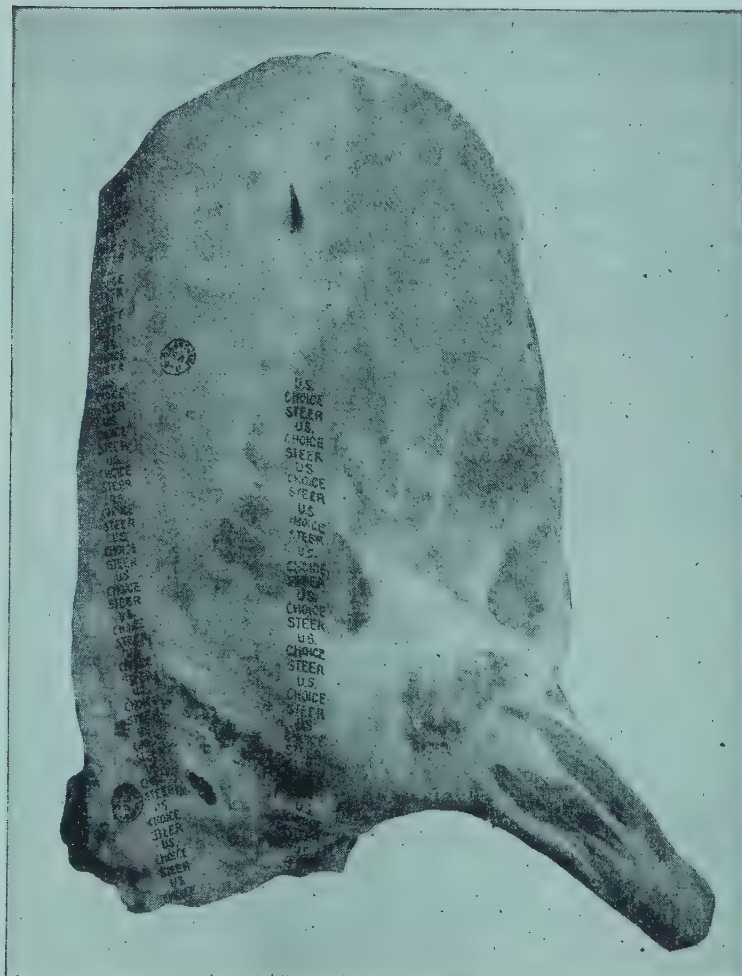
nection whatever. The confusion perhaps arises because both services are carried out by government representatives, and in both cases the meat receives a government stamp. The inspection stamp (Fig. 77), however, simply means that the animal was sound and free from disease—hence, that the meat is wholesome.

All meat designed for interstate commerce must be federally inspected, according to a government regulation. Since many packing companies, especially the larger ones, ship their products from one state to another they are operated under federal inspection. This means that about 73 per cent of the beef produced in the country is thus inspected.

PACKER GRADING AND BRANDING

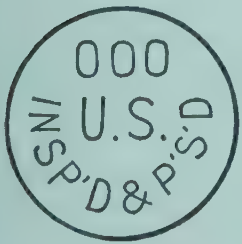
All beef is graded with extreme care in the packing plant by specially trained men who go over each carcass twice, once after it is split into sides and again after it is "ribbed" or cut into quarters. Information concerning this grading does not reach the consumer directly, since the grade label, with numbers on it that indicate grade and sex to the initiated, is simply pinned to the carcass and usually drops off before the meat is sold in the retail market. The last figure on this label designates grade, the first one sex. Thus one packer marks steer labels 10 for prime, 11 for choice, 12 for good, and so on down; heifer labels 20, 21, and 22 for prime, choice, and good; and cow labels 31 for choice —there are no prime cows—32 for good, and on down to 39 for the very lowest, or canner, grade. The numeral used to designate sex, however, varies with different packers. One packer, for example, uses 2 for steers, 3 for heifers, and 4 for cows; thus a prime-steer label of this packer would read 20, a prime heifer 30. Yet another packer uses 3 for steers, 4 for heifers, and 5 for cows and places a zero between the number indicating sex and that indicating grade, which makes prime-steer labels read 300 and prime heifers 400.

Although, as just stated, the consumer does not see these labels and probably would not be able to interpret them if he



Courtesy of the U.S. Department of Agriculture

FIG. 76.—Forequarter of beef, United States government graded and stamped. At present the word "steer" is omitted and the letters "U.S.D.A." added at intervals. The stamp is the government's guaranty of quality. The packers also stamp beef to indicate quality, but they use trade-names rather than "prime," "choice," etc.



Courtesy of the U.S. Department of Agriculture

FIG. 77.—United States government inspection stamp. This stamp certifies that the animal was sound. In actual use the zeros are replaced by numbers which indicate the packer and identify the carcass.

did, yet the grading they stand for is of general importance, because of its relationship to prices, as already indicated, and to brands, as is shown in Table 18. This table, it will be noted, gives the brand names for four big packing companies. These names are stamped on the forequarters and hindquarters in such a way that practically every retail cut carries a section of the stamp. Therefore, the consumer should have no difficulty in learning what characteristics to expect in a certain brand. Only

TABLE 18

RELATION BETWEEN BRAND NAME AND GRADE OF BEEF OF FOUR LARGE PACKING COMPANIES

Brand Name				Approximate Grade, Packers' System, of Steer and Heifer Carcasses	
Armour and Company	Cudahy Packing Company	Swift and Company	Wilson and Company, Inc.	Grade No.	Description
Star	Puritan	Premium	Certified	0 1 2	Prime and choice
Quality	Fancy	Select	Special Ideal	3	Good
Banquet None	Cudahy Cudahy	Arrow None	Leader Wilsco	4 5	Commercial

steer and heifer carcasses are branded, and of these probably nearly all that are graded 0, 1, and 2 (prime, choice, and good) and some of those graded 4 and 5 (commercial) are included.

UNITED STATES DEPARTMENT OF AGRICULTURE GRADING AND STAMPING

Until January 1, 1943, government grading was optional and was carried out only on consumer demand. As a result, the percentage of beef so graded was small, as can be seen by consulting Table 19. On the first of January, 1943, however, grading was made obligatory for all beef, regardless of whether or not it had been federally inspected, save for such of the cutter and canner quality as was used by the packers in making sausage. On July 1,

1943, a further ruling was made that even these lower qualities must be graded, whatever the use to which they were put.

The requirement that nonfederally inspected beef must also be graded has led to a slight difference in the way carcasses are marked. If they have been federally inspected, they are stamped "U.S. Choice," "U.S. Good," "U.S. Commercial," or whatever the grade may be, and, in addition, the letters "U.S.D.A." are added at intervals. These words and letters go from one end of

TABLE 19*

FEDERAL INSPECTION AND GRADING OF BEEF

Year	Beef Slaughtered under Federal Inspection (Pounds)	Graded and Accepted (Includes Fresh, Frozen, and Cured) (Pounds)	Beef Graded as Per Cent of Beef Slaughtered under Federal Inspection
1937	4,699,000,000	411,000,000	8.7
1938	4,798,000,000	606,000,000	12.6
1939	4,803,000,000	514,000,000	10.7
1940	4,971,000,000	580,000,000	11.7
1941	5,739,000,000	792,000,000	13.8
1942	6,347,000,000	1,480,000,000	23.3
1943	5,970,000,000	6,693,000,000	112.1
1944	6,655,000,000	8,332,000,000	125.2

* Source: Livestock Branch, Production and Marketing Administration, U.S. Department of Agriculture.

the carcass to the other, as indicated in the quarter shown in Figure 76.

If, however, carcasses are from nonfederally inspected plants, they are graded and stamped simply as "Choice," "Good," and so on down the side, with the letters "U.S." and "U.S.D.A." omitted. (And on such carcasses there is, of course, no federal inspection stamp.)

In some isolated regions where a government grader was not available, the O.P.A. permitted the packer to do the grading, in which case letters only were used to designate grade, and these were stamped on each wholesale cut. Thus, choice was stamped "AA"; good, "B"; and so on.

The fact that some of the words used in the government sys-

tem—"Choice" and "Good," for example—actually tell the grade, gives this system an advantage over packers' branding, in which the consumer must learn to associate quality with certain unrelated words.

The obvious advantage in buying meat that is graded and stamped by the government or by the packers is that one does not have to depend solely on the retailer's word or one's own estimate for quality.

The purpose of the foregoing discussion has been, as was stated in the beginning, to give the household buyer an idea of the relative merits and availability of the various grades of meat on the market and thus enable her to understand the wide difference in the cost of identical cuts as found in different shops.

PROPERTIES AND LOCATION OF CUTS OF BEEF

According to our standards of excellence, the most desirable cuts of beef are those which are tender and juicy when cooked by dry heat—roasted or broiled—and which provide relatively thick pieces of lean which can be sliced across the grain for serving. The only cuts that can be counted on to fill all these requirements are the loin and rib, about 25 per cent of the whole carcass. The others fall short in one or more respects. How the different parts of an animal vary with respect to muscle size and, to a certain extent, with direction is something anyone can see for himself if he has the opportunity to observe a few beef carcasses being divided into wholesale and retail cuts or, failing that, if he examines the photographs and drawings given in this chapter. How the parts vary with respect to tenderness is a matter concerning which we have but little definite information and therefore have to rely upon popular opinion as expressed by consumer preference. What is needed is more mechanical measurements of the tenderness of different parts cooked by the same method, also more physical and chemical measurements of the factors known, or supposed, to contribute toward tenderness, such as the size of muscle fibers and the amount and kind of connective tissue.

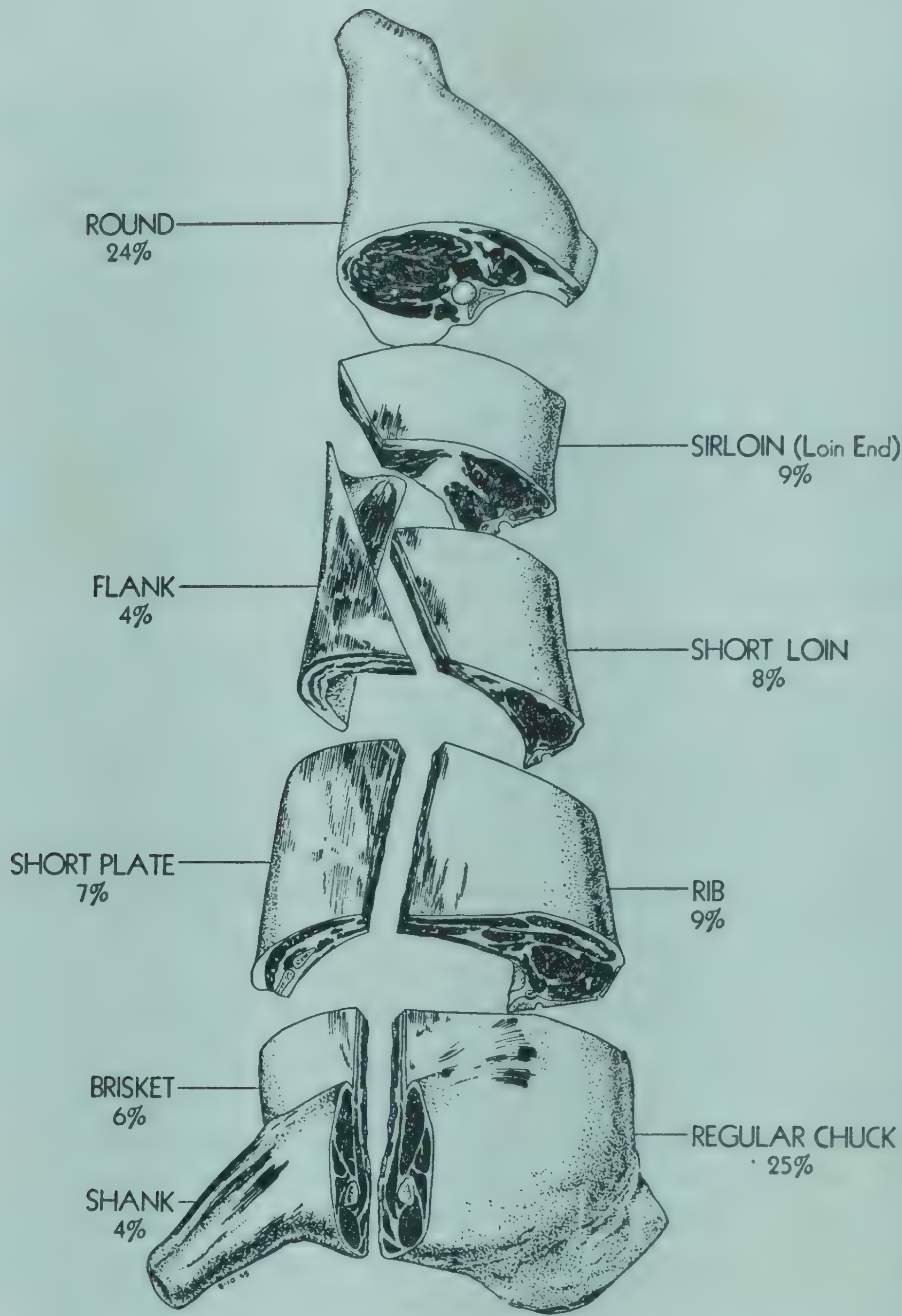
Before attempting to compare the quality of different parts of a beef carcass, it is necessary to adopt some method of cutting and naming the parts. Any number of methods have been employed,[2] about as many, in fact, as there are cities in the United States and Canada; but only four have been widely recognized, and these are the ones used in Chicago, New York, Philadelphia, and Boston, all of which were discussed in the 1933 edition of this book. The present trend, however, has narrowed down to the Chicago method, and this is the only one that will be considered in this edition. Whatever the method employed, however, the general purpose of all was to separate the more tender cuts from the less tender ones and the thicker sections from the thinner.

PROPERTIES AND LOCATION OF CUTS MADE BY THE CHICAGO METHOD

According to the Chicago method, the side of beef is separated between the twelfth and thirteenth ribs into forequarters and hindquarters. The forequarter is then divided into the rib cut, which includes seven ribs; the regular chuck, which includes the remaining five ribs, the neck, and the shoulder-arm section; the foreshank or the front leg; the brisket, lying below the chuck; and the short plate or navel, below the rib cut. (The word "plate" is commonly used to designate the whole cut lying below the chuck and ribs.) The hindquarter is divided into the short loin, a section including the thirteenth rib and extending to a point just in front of the "pin" or "hip" bone; the sirloin (loin end), which includes the hip-bone section and extends from the short loin to the round; the flank, a triangular section lying immediately below the loin; and the round, including the rump. The whole loin may be and frequently is bought in one piece, but the retailer will separate the two parts if steaks on either side of the dividing line are called for.

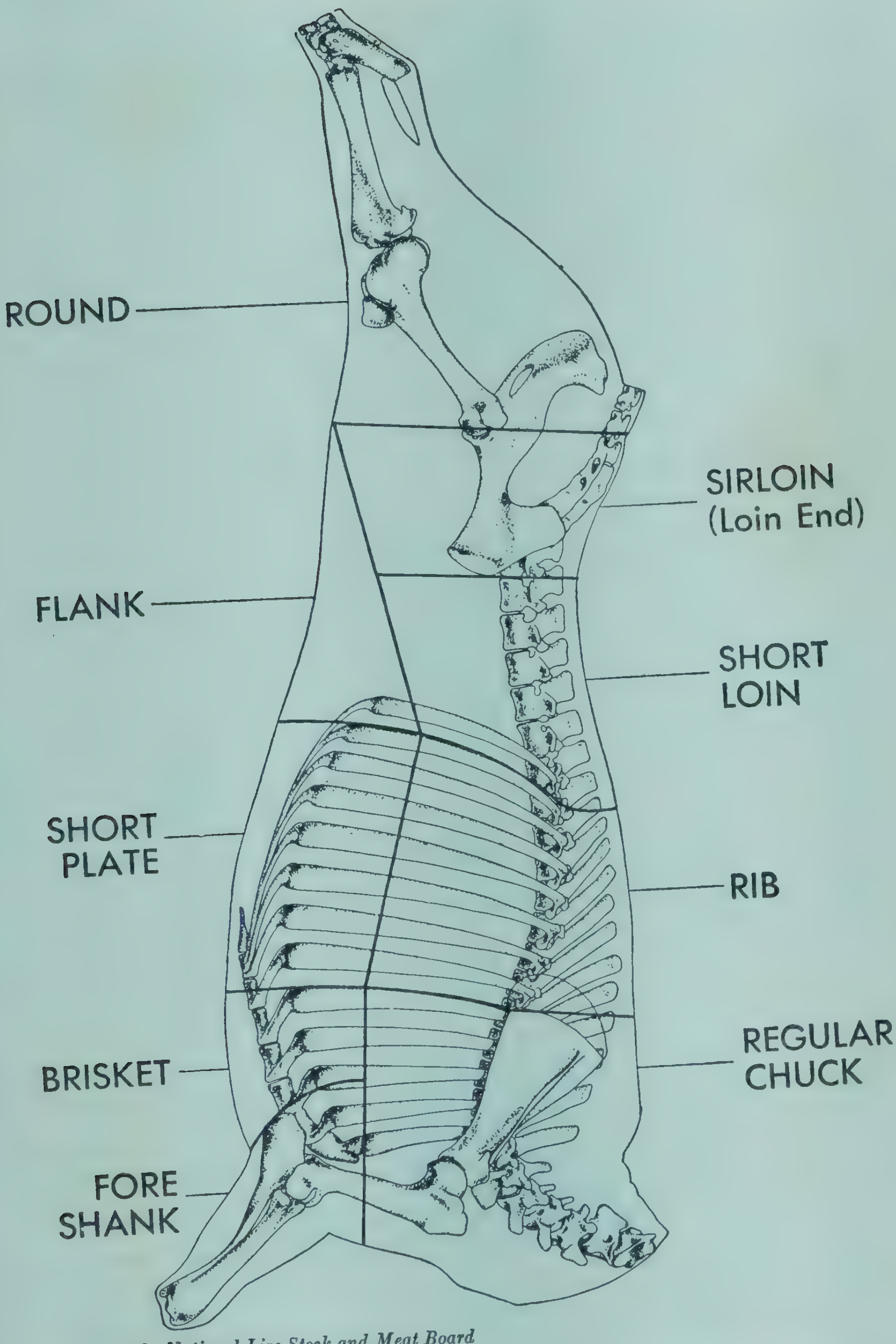
An examination of Figures 78–80 will clarify what has just been said with reference to the location of the various cuts. Figure 78 gives a general idea of the contour, appearance, and percentage distribution of the cuts of both the forequarter and

[2] A. C. Schueren, *Meat Retailing* (Chicago: Vaughan Co., 1927).



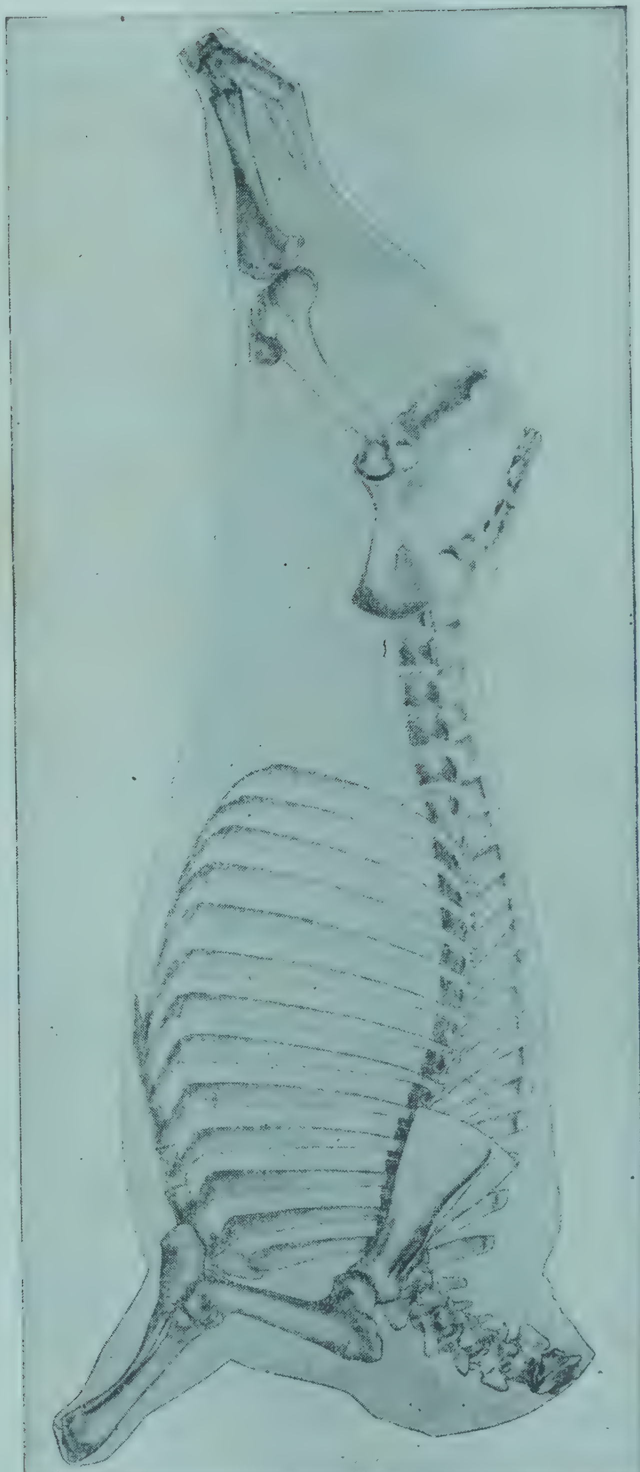
Courtesy of the National Live Stock and Meat Board

FIG. 78.—Wholesale cuts of beef



Courtesy of the National Live Stock and Meat Board

FIG. 79.—Location with respect to bones of wholesale cuts of beef



Courtesy of the National Live Stock and Meat Board

FIG. 80.—Beef skeleton. Note the ridge on the shoulder blade. This forms the top of the 7 in blade pot roasts. Note also the T-shaped bones of the lumbar vertebrae.

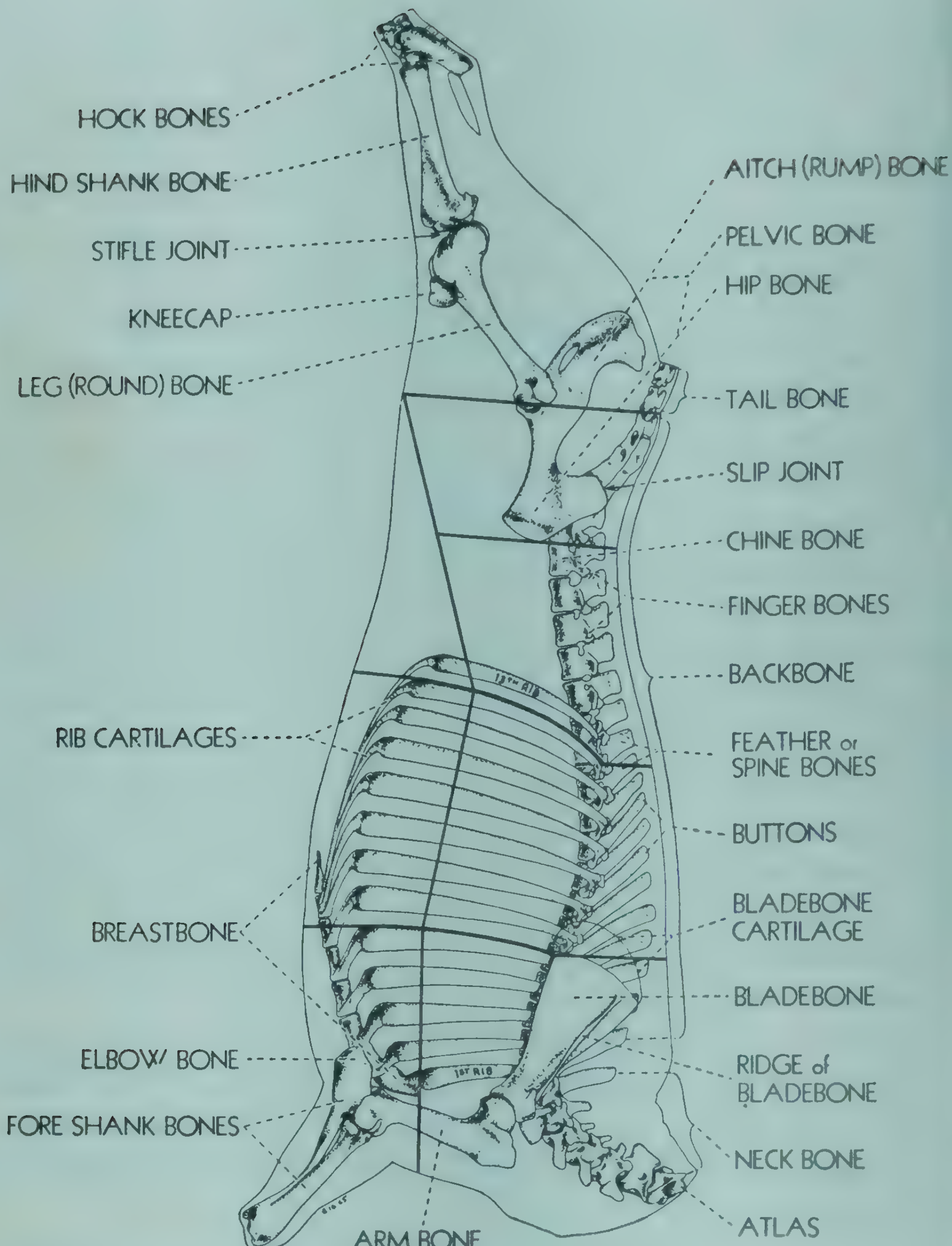
the hindquarter, while Figures 79 and 80 indicate the location and relative amount of bone.

Since the loin is the choicest cut and therefore in a way may be thought of as setting the standard to which all others are referred, it will be discussed first, with the rib, round, and other parts following. In this discussion a method of making retail cuts is described and illustrated. Obviously, it is not the only method which could be employed. There is, in fact, no one uniform method of making retail cuts from any given set of wholesale ones. The plan followed by each retailer depends somewhat upon his own ideas on the subject and the preference of his customers. The particular method given here was chosen because it provides pieces of a suitable size for a small family.

Attention should perhaps be called to the fact that in small retail shops where meat is cut for each individual customer, in general only those pieces are available which lie on the outside of that particular portion of the wholesale cut which the retailer happens to have in stock at the moment. Thus, one should not expect to obtain a round-bone sirloin until the wedge bone on one side, or double bone on the other, has been disposed of. In some large shops, however, in which wholesale cuts are divided into retail ones early in the morning and placed in a well-refrigerated showcase in anticipation of the day's trade, practically any cut may be available.

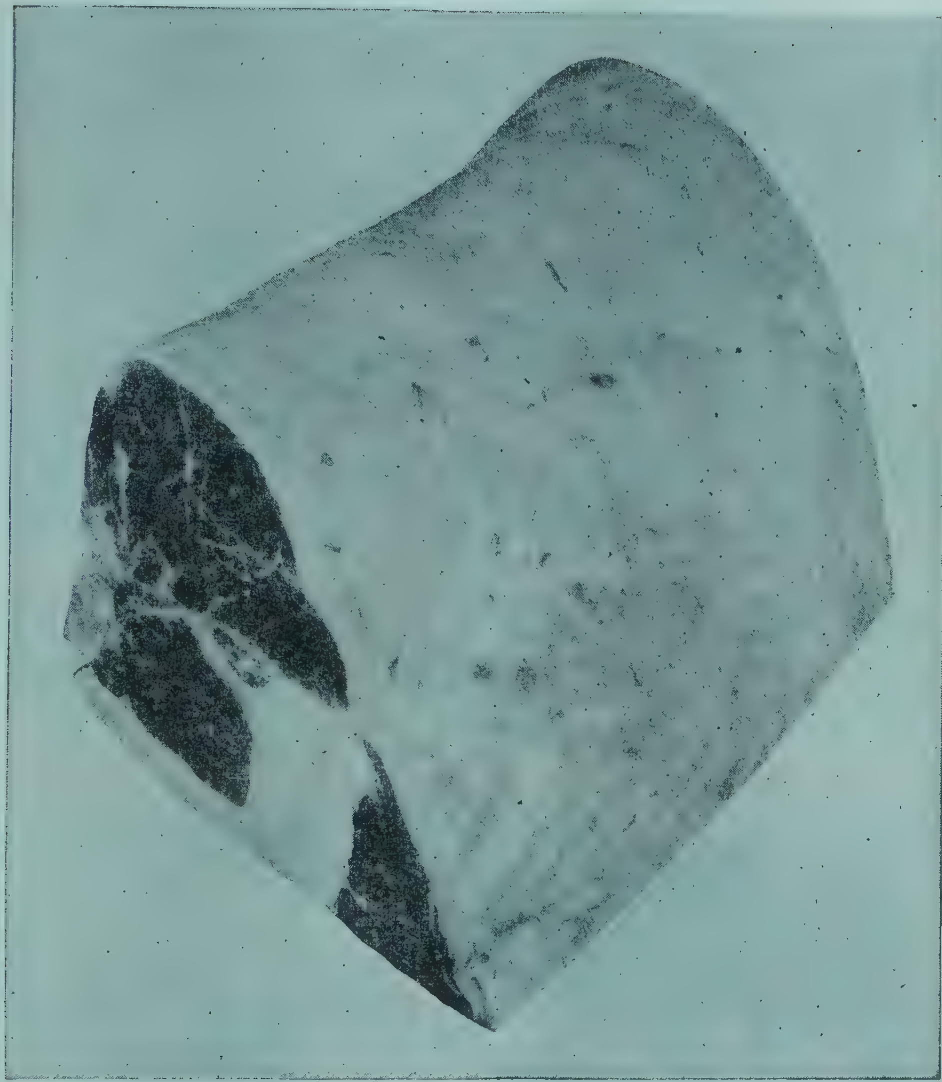
The loin.—The loin contains two large, tender muscles, the *psoas major*, otherwise known as the "tenderloin," or "fillet" when removed from the loin and sold separately, and the *longissimus dorsi*, or the "loin muscle," which extends practically the whole length of the body.

The short loin (Fig. 82), that part of the loin next the rib, is more prized than the sirloin (loin end) because it contains the major portion of the tenderloin. This muscle arises at a point just beyond the first club steak and gradually increases in size until it reaches its maximum width in the first porterhouse steak —or, as we have designated it in Figures 82 and 85, the twelfth cut of the short loin. These facts are well illustrated by Figures



Courtesy of the National Live Stock and Meat Board

FIG. 81.—Names of the bones commonly used in identifying cuts of beef. Some retailers call the twelfth rib the "first" and number toward the neck.



Courtesy of the National Live Stock and Meat Board

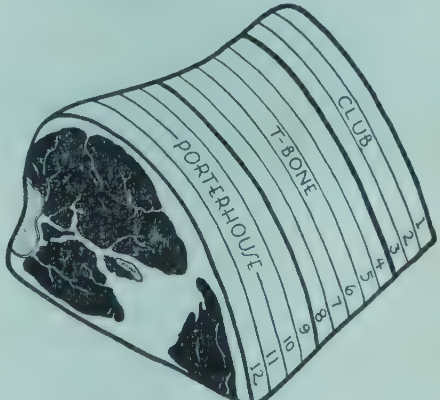
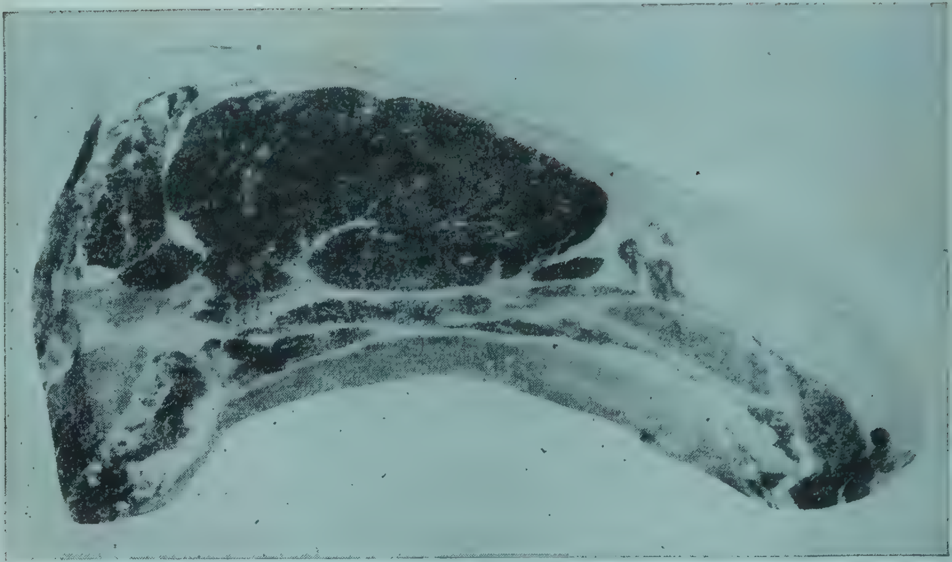
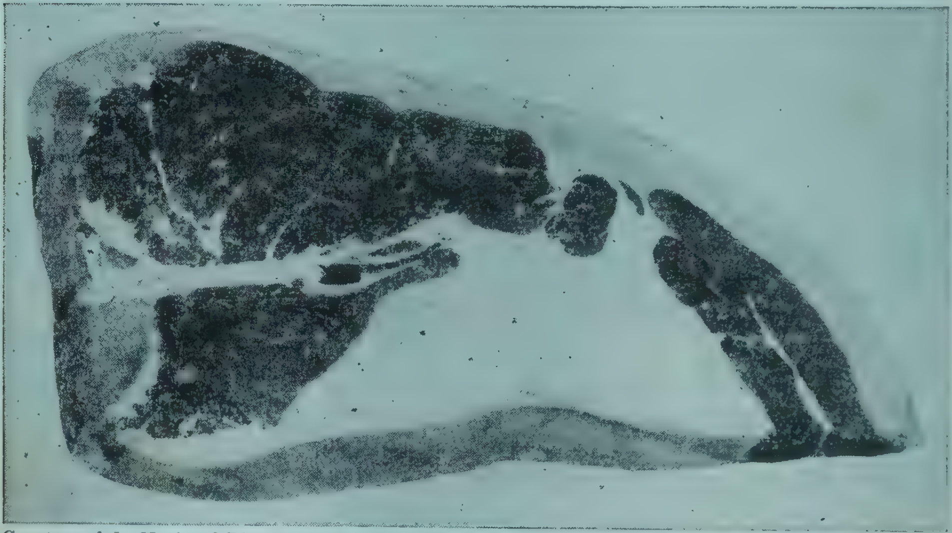


FIG. 82.—The short loin. The face shown in the photograph was separated from the loin end; it represents one side of the first porterhouse steak (see Fig. 85). The diagram shows the location of the different types of short-loin steaks and the method of numbering employed in the tables.



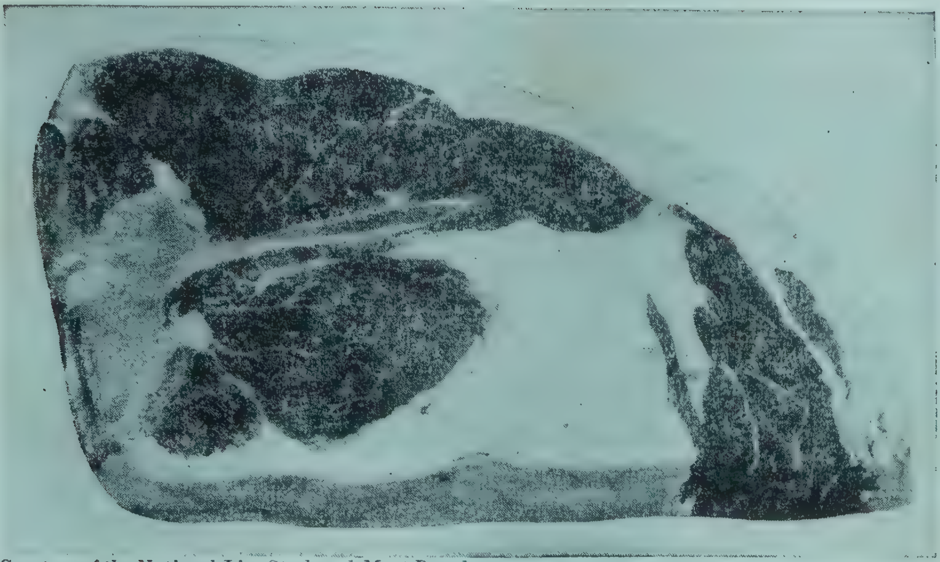
Courtesy of the National Live Stock and Meat Board

FIG. 83.—Club or Delmonico steak. First 1-inch short-loin steak (beginning to number from the side of the short loin adjacent to the rib cut; for exact location see Fig. 82). From a 450–500-pound carcass: weight, as purchased, untrimmed, 1 pound; yield, 2 servings, each about $1 \times 2 \times 3$ inches, 100 grams ($3\frac{1}{2}$ ounces) when cooked. This steak contains the thirteenth rib.



Courtesy of the National Live Stock and Meat Board

FIG. 84.—T-bone steak. Seventh 1-inch short-loin steak (beginning to number from the side of the short loin adjacent to the rib cut; for exact location see Fig. 82). From a 450–500-pound carcass: weight, as purchased, untrimmed, $1\frac{1}{4}$ pounds; yield, 2 servings without tail (flank end), $2\frac{1}{2}$ with tail, each about $1 \times 2 \times 3$ inches, 100 grams ($3\frac{1}{2}$ ounces) when cooked. A small section of the shaft of the T is shown in the center of the steak. The tenderloin, the muscle below the bone, is fairly large.



Courtesy of the National Live Stock and Meat Board

FIG. 85.—Porterhouse steak. Twelfth 1-inch short-loin steak (beginning to number from the side of the short loin adjacent to the rib cut; for exact location see Fig. 82). Most retailers call this steak the "first porterhouse." From a 450–500-pound carcass: weight, as purchased, untrimmed, 2 pounds; yield, 3 servings without tail (flank end), $3\frac{1}{2}$ with tail, each about $1 \times 2 \times 3$ inches, 100 grams ($3\frac{1}{2}$ ounces) when cooked. In this steak the tenderloin, the muscle below the bone, is at its widest.

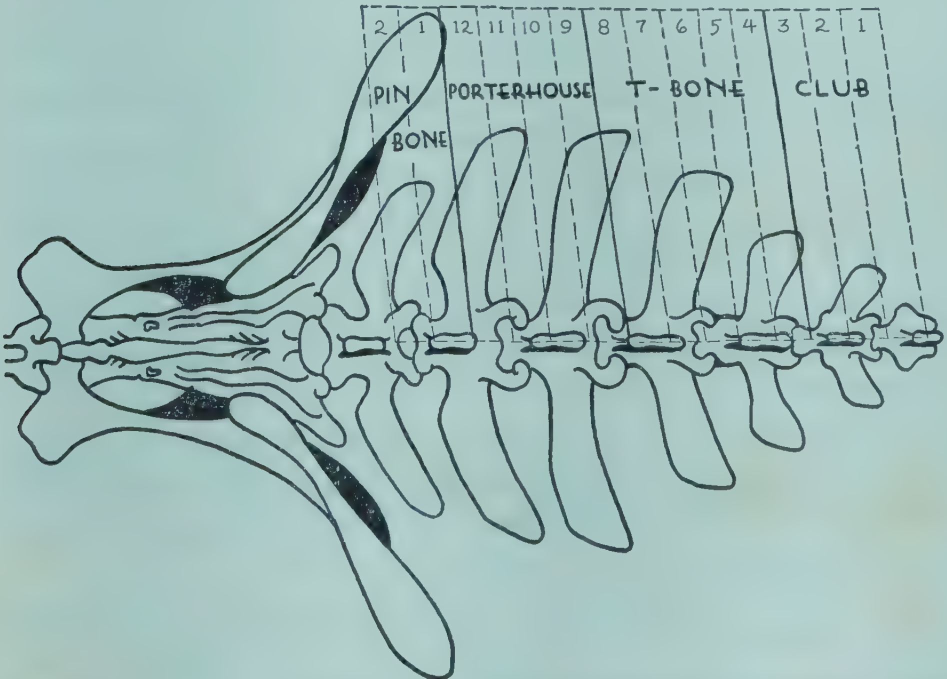


FIG. 86.—Face view of T-bones (lumbar vertebrae; see Fig. 81). The transverse processes which form the shaft of the T-bones are an inch or more apart; hence not all steaks in this region contain a whole T-bone. Thus, only the tip of the shaft is shown in the steak of Figure 84.

83, 84, and 85, which show, respectively, a club steak with no tenderloin, a T-bone with a medium-sized section, and a porterhouse with a large section of this muscle.

Hitherto the terms "T-bone," so called because of the shape of the bone, and "porterhouse" have been applied more or less synonymously to all short-loin steaks with an appreciable amount of tenderloin. There is a growing tendency, however, to confine the use of the term "porterhouse" to those steaks in which the size of the tenderloin approaches the size of the *longissimus* and to reserve the name "T-bone" for those steaks lying between the porterhouse thus defined and the club or Delmonico (see Fig. 82). But obviously no sharp line can be drawn between the two, hence the terms "porterhouse" and "T-bone" will probably continue to be used more or less interchangeably.

In looking at the picture of the T-bone steak the reader will observe that, surprisingly enough, it is without a T-bone. The reason for this will be clear if one looks at Figure 86, which is a drawing of the lumbar vertebrae (see Fig. 81 for location of these vertebrae), the section of the spine containing the "T-bones," the shaft of which the anatomist calls the "transverse processes." These processes are an inch or more across and about the same distance apart, hence 1-inch steaks like those shown here cannot possibly all contain a whole T-bone. Since the transverse processes tend to curve, scimitar fashion, some of the steaks contain only a small section of this bone, far removed from that part of the backbone with which it articulates to form the T.

The name "club"—or Delmonico—does not always designate exactly the same type of steak. Properly speaking, it probably means a steak with no tenderloin, but it is often applied to those with a small piece of this muscle.

The face of the short loin and the location of the different types of steaks obtained from it are shown in Figure 82.

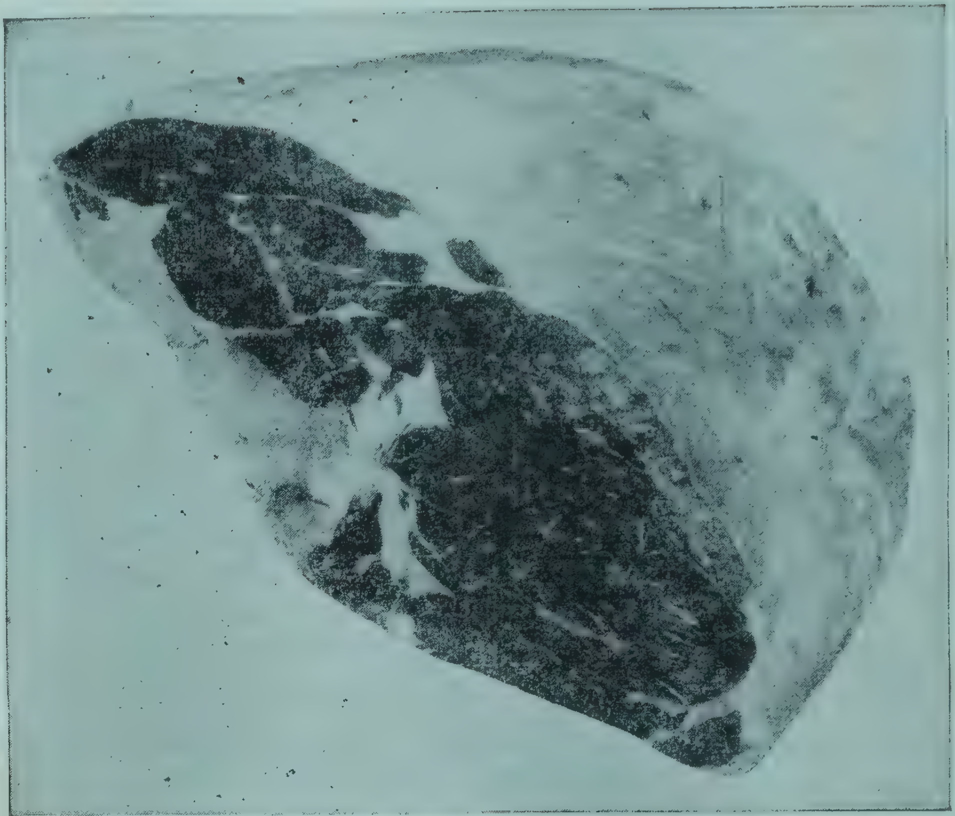
The sirloin or loin-end steaks are named according to the type of bone they contain. The first ones on the side next to the

short loin are called "pin-bone" steaks because they contain the end of the hip or "pin bone." This bone occupies so much space that it lowers the demand for these steaks. The next ones in the order in which they occur are called, respectively, "double-bone," "round-bone," and "wedge-bone" steaks. The general appearance of each may be seen by examining Figures 88–95. It will be observed that those next to the round have some of their muscles running lengthwise; therefore, they are likely to be slightly less tender than the other steaks of this cut.

The face of the sirloin adjacent to the round and the location of the different types of steaks obtained from it are shown in Figure 87.

The rib.—The choicest part of the rib cut is that adjacent to the short loin, the least choice that next the chuck. In the one there is a large portion of the tender *longissimus dorsi*, here commonly called the "rib eye," while in the other there is a smaller portion of this muscle and a rather large portion of thin, less tender muscles, some of them cut lengthwise of the fibers. The relative sizes of the different types of muscles can be seen by looking at Figures 96 and 97, which show the faces of the rib roasts containing the tenth, eleventh, and twelfth; eighth and ninth; and sixth and seventh ribs. Cut thus, the roasts are of about equal weight. Ribs 8–12 sell at the same price; ribs 6 and 7 are usually cheaper and a good bargain. In these it is an excellent plan to have the retailer lift the thin, less tender muscles off the top, including with them the meat from the thin end of the ribs, and replace them by a pounded piece of cod fat held in place by a string or skewer. The less tender muscles can then be rolled and cooked by moist heat, which will make them more tender than does the dry heat used for the tender rib eye.

To make roasts of a convenient size for a small family the rib is sometimes divided into four—in place of three—sections, containing, respectively, ribs 11 and 12, 9 and 10, 7 and 8, and 6. The approximate weight of such roasts is given in Table 22 (p. 305).



Courtesy of the National Live Stock and Meat Board

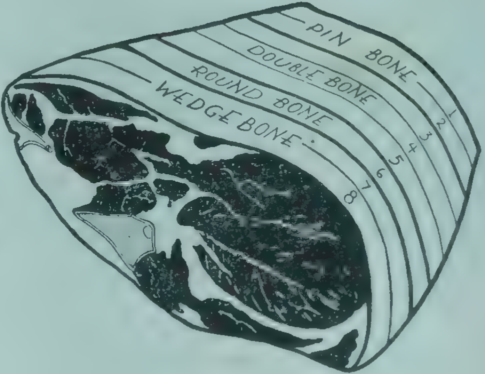


Fig. 87.—The sirloin (loin end). The face shown in the photograph was separated from the rump and round (see Fig. 78). The diagram shows the location of the different types of loin-end or sirloin steaks and the method of numbering employed in the tables.

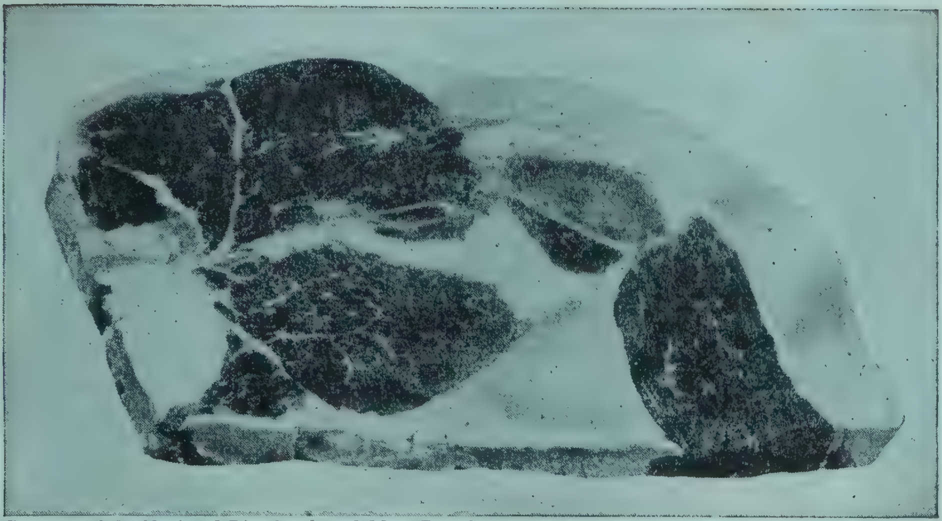


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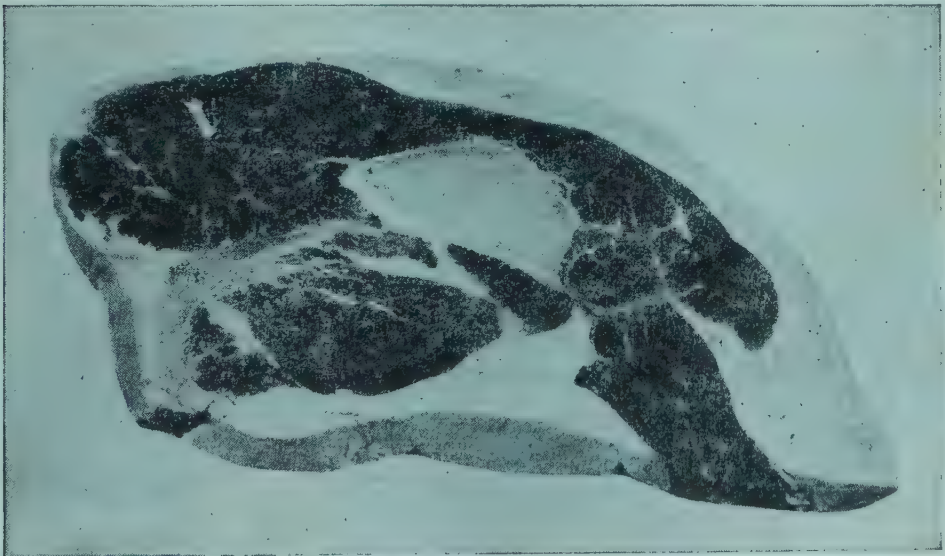
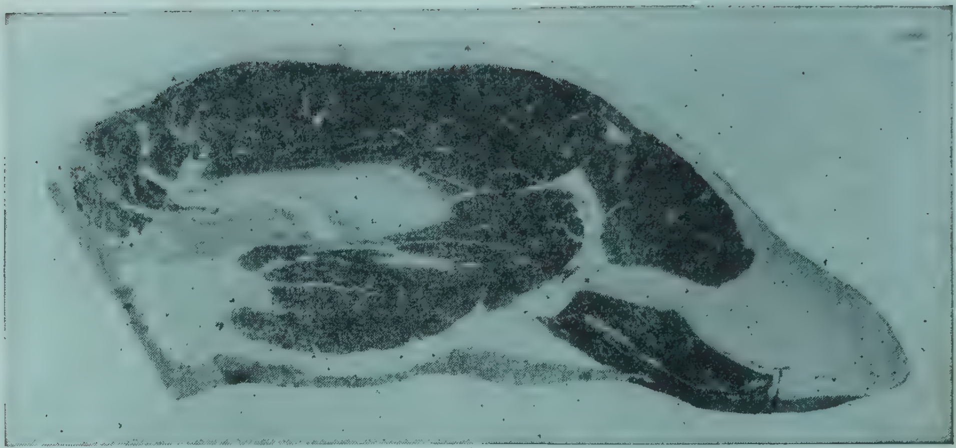
FIG. 88.—Pin-bone sirloin steak. First 1-inch loin-end steak (beginning to number from the side of the loin end adjacent to the short loin; for exact location see Fig. 87). From a 450–500-pound carcass: weight, as purchased, untrimmed, $2\frac{1}{2}$ pounds; yield, $2\frac{1}{2}$ servings without tail (flank end), $3\frac{1}{2}$ with tail, each about $1 \times 2 \times 3$ inches, 100 grams ($3\frac{1}{2}$ ounces) when cooked. Note that this steak contains the tip end of the pin bone at the upper right center.



Courtesy of the National Live Stock and Meat Board

FIG. 89.—Pin-bone sirloin steak. Second 1-inch loin-end steak (beginning to number from the side of the loin end adjacent to the short loin; for exact location see Fig. 87). From a 450–500-pound carcass: weight, as purchased, untrimmed, $2\frac{1}{2}$ pounds; yield, $3\frac{1}{2}$ servings without tail (flank end), 5 with tail, each about $1 \times 2 \times 3$ inches, 100 grams ($3\frac{1}{2}$ ounces) when cooked. Note that the pin bone, one of the identifying features, lies at the upper center of the steak.



Courtesy of the National Live Stock and Meat Board

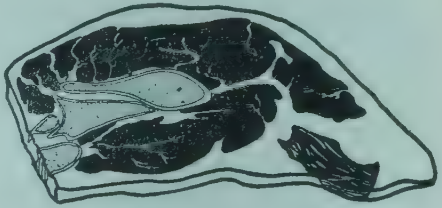


FIG. 90.—Double-bone sirloin steak. Third 1-inch loin-end steak (for exact location see Fig. 87). From a 450–500-pound carcass: weight, as purchased, untrimmed, $2\frac{1}{2}$ pounds; yield, 5 servings, each about 1×2×3 inches, 100 grams ($3\frac{1}{2}$ ounces) when cooked. Note that in this steak and in the following ones the two bones which form the "double bone" lie adjacent to each other and that the longer of the two extends from nearly the center to almost the left edge of the steak.

Courtesy of the National Live Stock and Meat Board

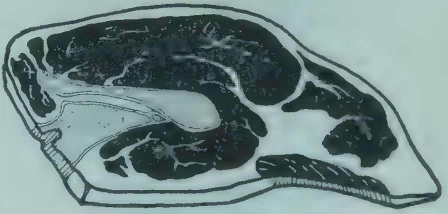
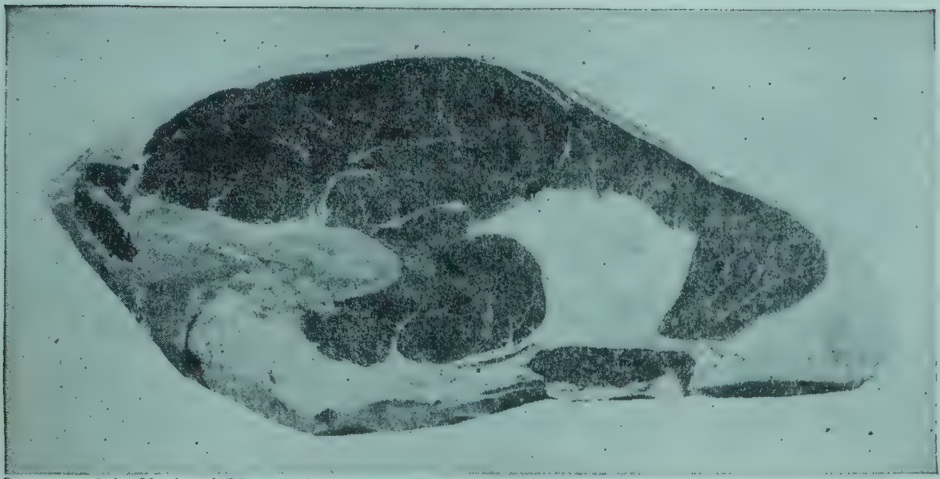
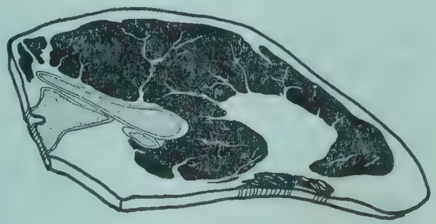


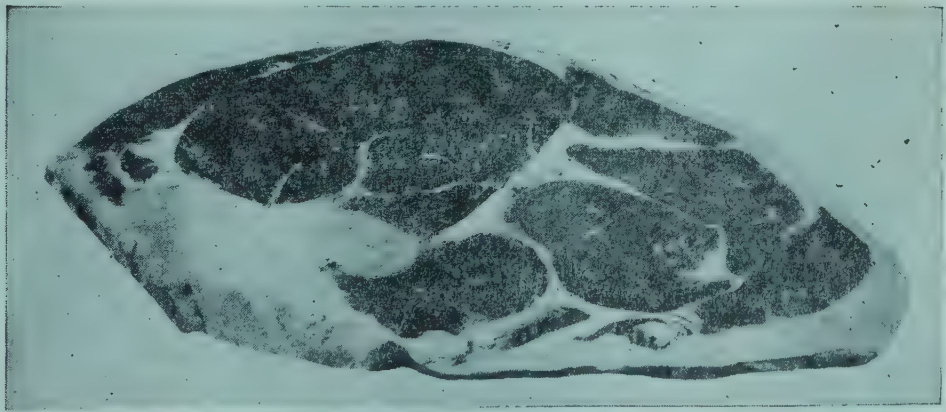
FIG. 91.—Double-bone sirloin steak. Fourth 1-inch loin-end steak (for exact location see Fig. 87). From a 450–500-pound carcass: weight, as purchased, untrimmed, 3 pounds; yield, 6 servings, each about 1×2×3 inches, 100 grams ($3\frac{1}{2}$ ounces) when cooked.



Courtesy of the National Live Stock and Meat Board

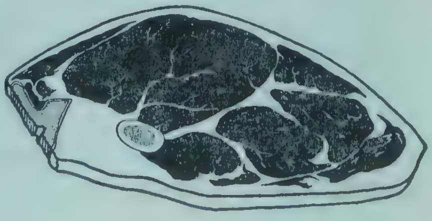
FIG. 92.—Double-bone sirloin steak. Fifth 1-inch loin-end steak (for exact location see Fig. 87). From a 450–500-pound carcass: weight, as purchased, untrimmed, 3 pounds; yield, 7 servings, each about 1×2×3 inches, 100 grams (3½ ounces) when cooked. It is within this steak that the longer of the "double bones" changes to a round bone.

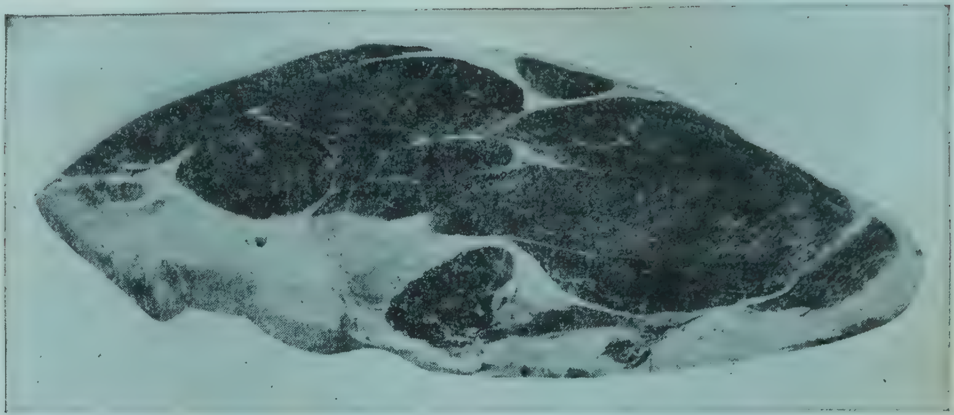




Courtesy of the National Live Stock and Meat Board

FIG. 93.—Round-bone sirloin steak. Sixth 1-inch loin-end steak (for exact location see Fig. 87). From a 450–500-pound carcass: weight, as purchased, untrimmed, 3 pounds; yield, 7 servings, each about 1×2×3 inches, 100 grams (3½ ounces) when cooked. Note that the round bone, one of the identifying features, lies at the lower left center of the steak.





Courtesy of the National Live Stock and Meat Board

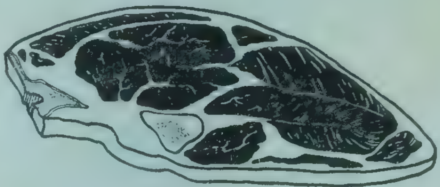
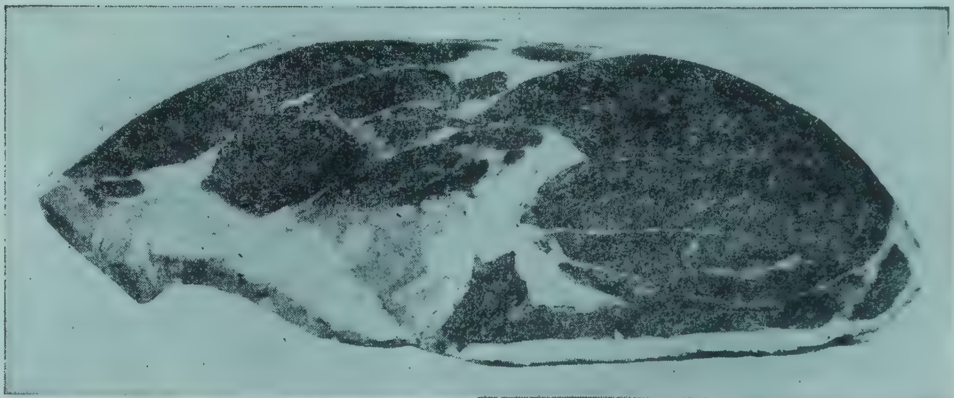


Fig. 94.—Wedge-(or round-)bone sirloin steak. Seventh 1-inch loin-end steak (for exact location see Fig. 87). From a 450–500-pound carcass: weight, as purchased, untrimmed, $3\frac{1}{2}$ pounds; yield, 9 servings each about $1 \times 2 \times 3$ inches, 100 grams ($3\frac{1}{2}$ ounces) when cooked. Note that in this and in the following steak, also, a large number of the muscles run lengthwise, and that the wedge-shaped bone, one of the identifying features, lies at the lower left center of the steak. It is within this steak that the bone changes from round to wedge shape.



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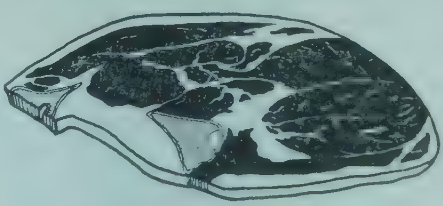
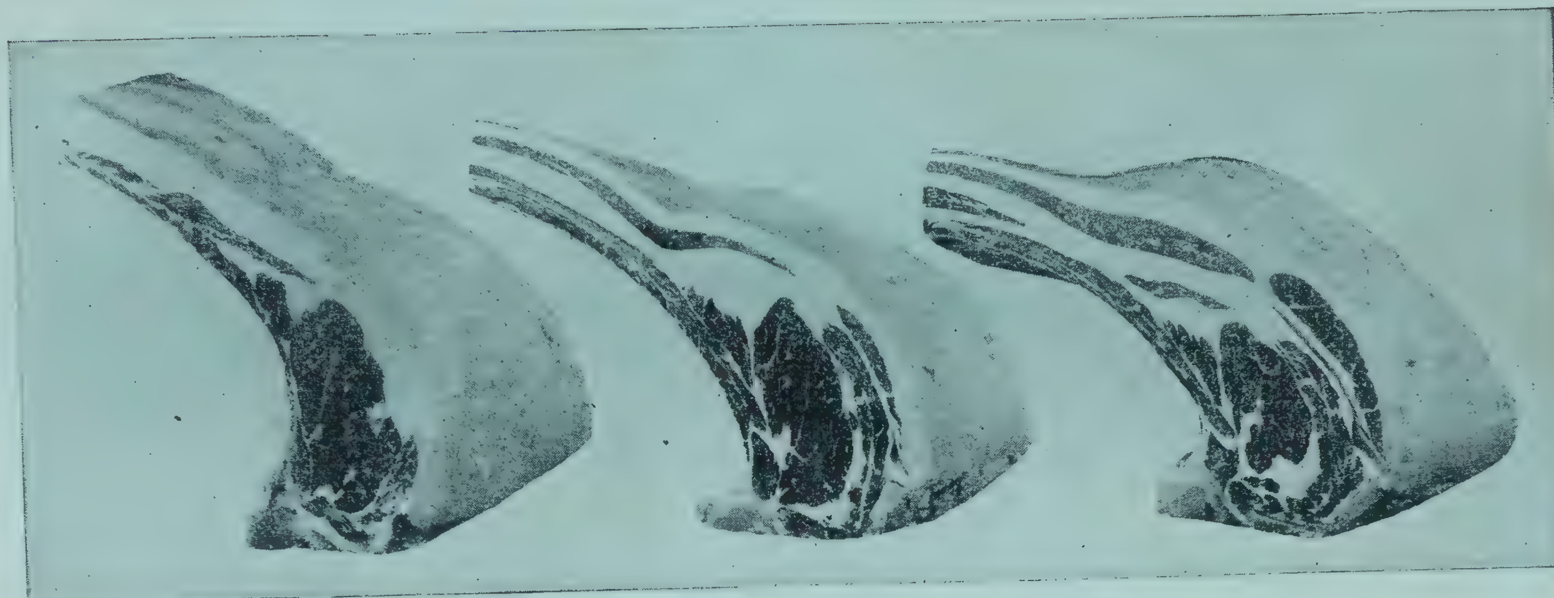
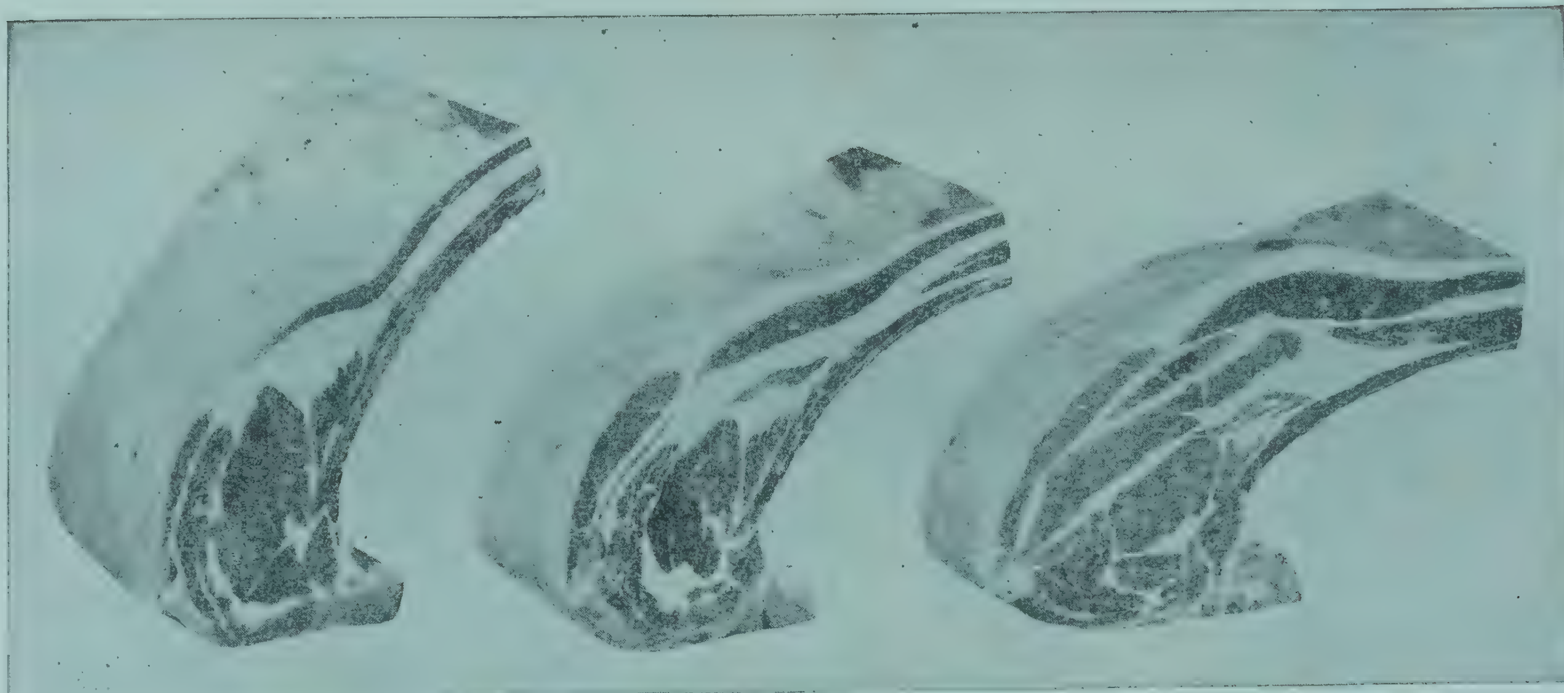


Fig. 95.—Wedge-bone or butt-end sirloin steak. Eighth 1-inch loin-end steak (for exact location see Fig. 87). From a 450–500-pound carcass: weight, as purchased, untrimmed, $3\frac{1}{2}$ pounds; yield, 10 servings, each about $1 \times 2 \times 3$ inches, 100 grams ($3\frac{1}{2}$ ounces) when cooked.



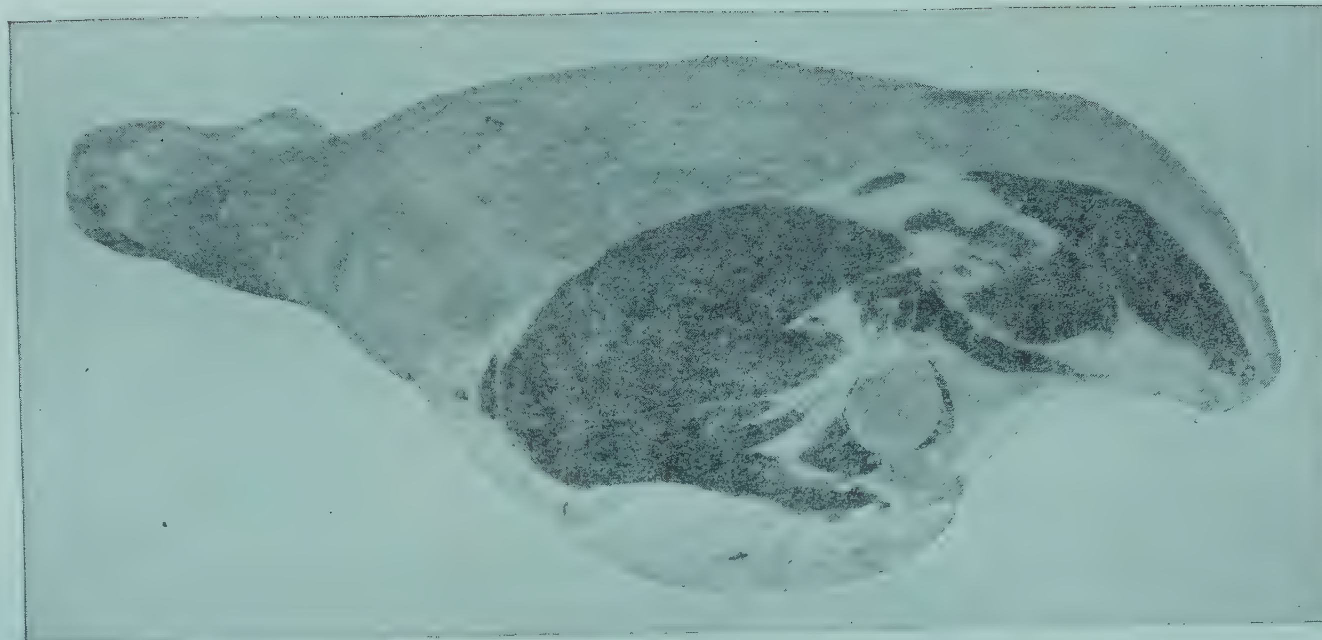
Courtesy of the National Live Stock and Meat Board

FIG. 96.—Rib roasts. The faces of ribs 12 (*left*), 9 (*center*), and 7 (*right*) are shown in the photograph. Note that in passing from rib 12 to rib 7 the inner muscle (rib eye) decreases in size and the outer, less tender muscles increase in size and number. For reverse view of these roasts see Figure 97.



Courtesy of the National Live Stock and Meat Board

FIG. 97.—Rib roasts. Reverse view of roasts pictured in Figure 96. In this photograph the faces of ribs 10 (*left*), 8 (*center*), and 6 (*right*) are shown. A section of the shoulder blade is seen in the upper center of rib 6 just below the small muscle.



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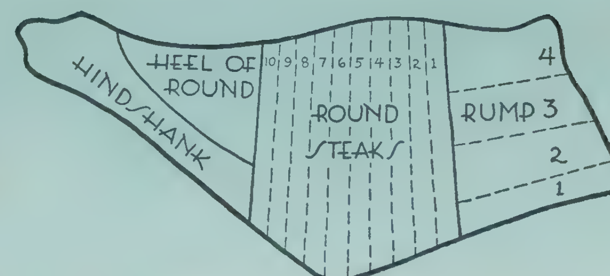
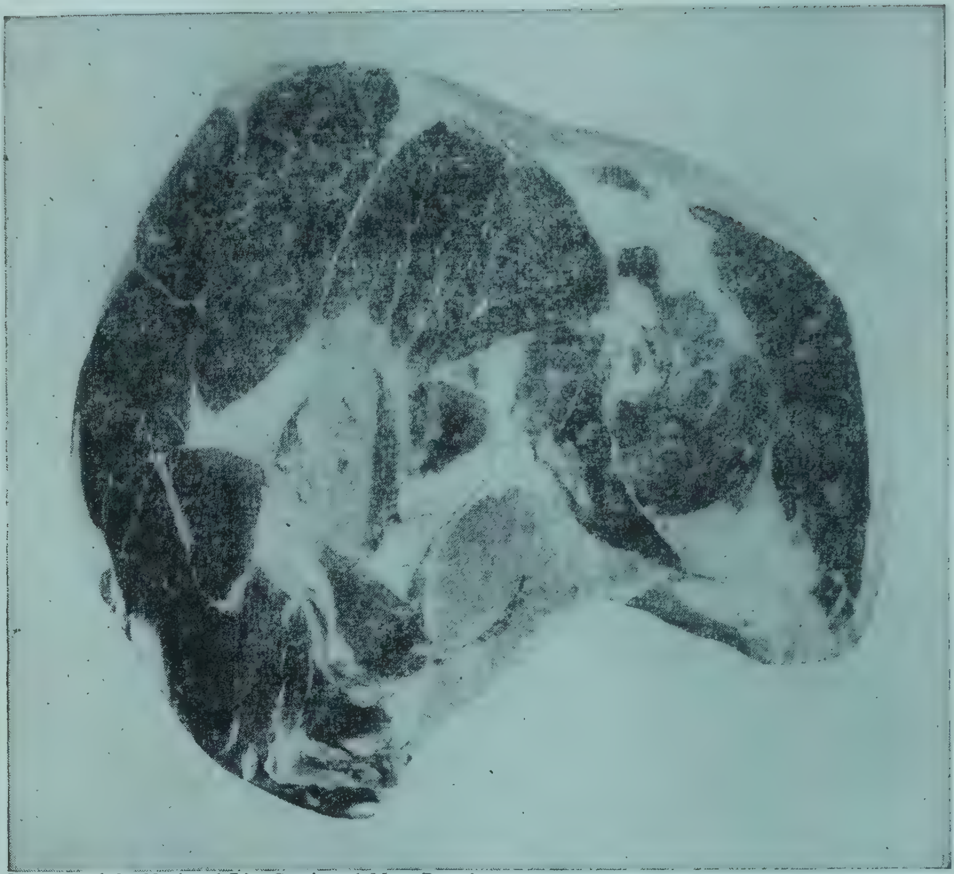


Fig. 98.—The round. The diagram shows a common method of dividing this cut into the rump, round steaks (the division is made a little to the left of the bone shown in the photograph), heel of round, and hind shank, together with a division of each into small retail cuts.

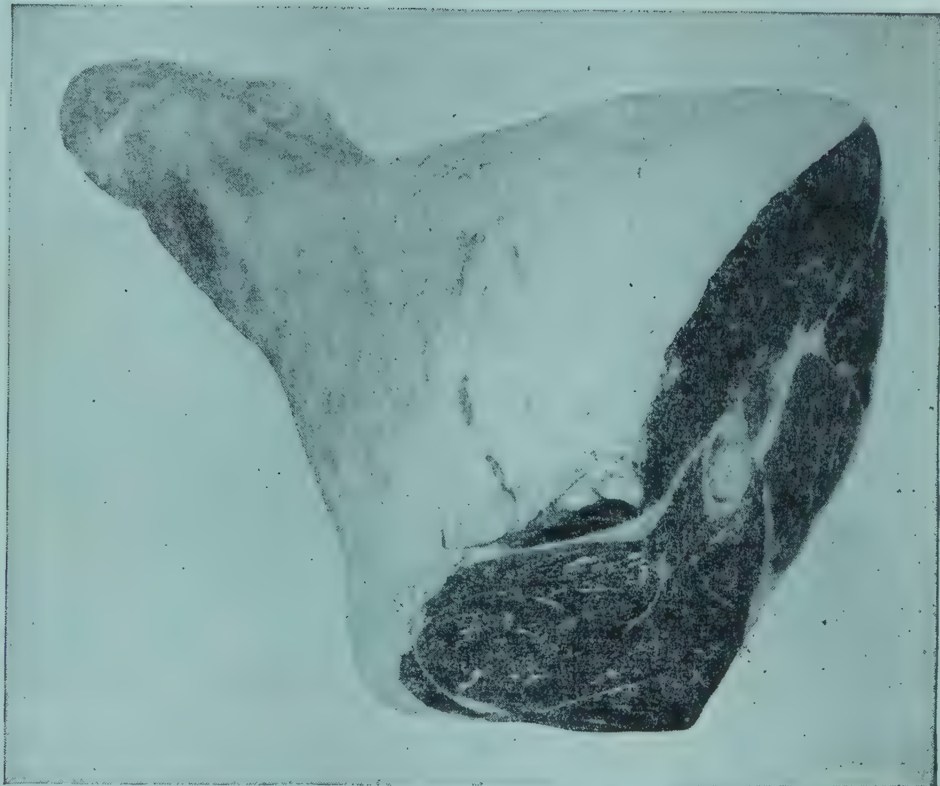


Courtesy of the National Live Stock and Meat Board

Fig. 99.—The rump. The face to the left was separated from the round, the one to the right from the loin. (The two faces join about midway between the two exposed surfaces of the knucklebone. This bone is removed before the rump is divided into retail cuts.)

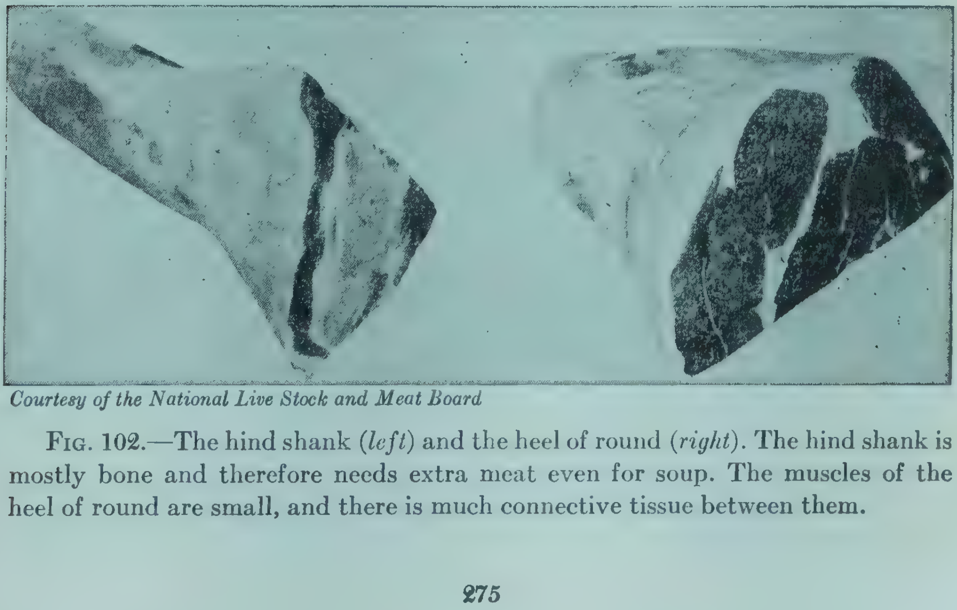
Courtesy of the National Live Stock and Meat Board

Fig. 100.—Sections 2 (*left*) and 3 and 4 in one piece (*right*) of the rump (for exact location of sections see Fig. 98). The face of section 1 is similar to that of section 2.



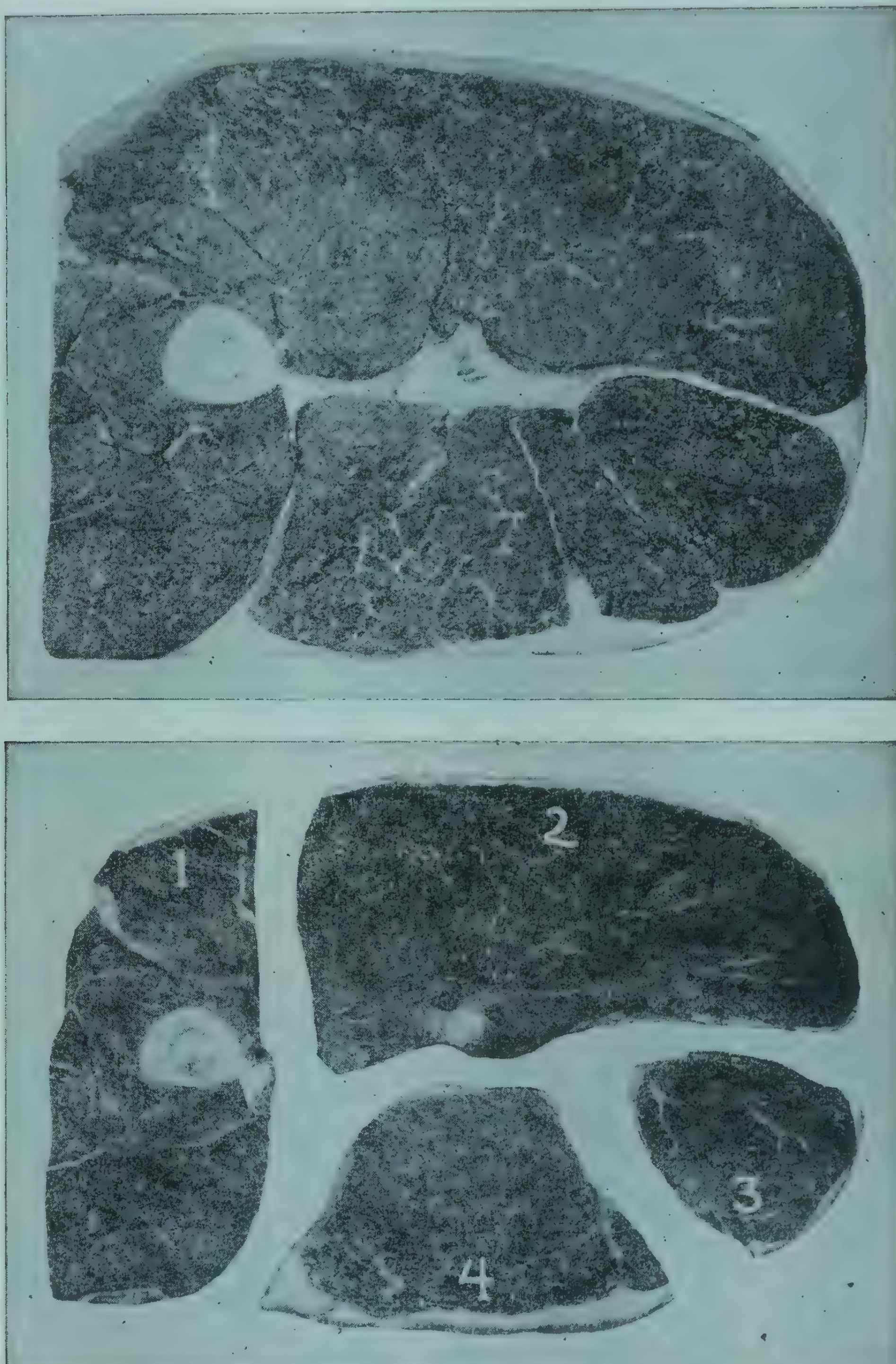
Courtesy of the National Live Stock and Meat Board

FIG. 101. Round, rump off. The face showing the round bone was separated from the rump. For details of muscles of the latter face see Figure 103.



Courtesy of the National Live Stock and Meat Board

FIG. 102.—The hind shank (*left*) and the heel of round (*right*). The hind shank is mostly bone and therefore needs extra meat even for soup. The muscles of the heel of round are small, and there is much connective tissue between them.



Courtesy of the National Live Stock and Meat Board

Fig. 103.—Round steak. The more tender muscles of the round are the sirloin tip and top of round (Nos. 1 and 2), and the less tender ones are the eye and bottom of round (Nos. 3 and 4).

Round.—The hind leg—or round—with the rump attached and a method of sectioning it into the rump, round steaks, heel of round, and hind shank are shown in Figure 98.

a) The rump (*Fig. 99*).—One characteristic of the rump is its odd-shaped bones, which make it rather difficult to carve after it is cooked. This probably is the reason why the meat-dealer frequently removes the bones and rolls the rump and sells pieces from the roll thus made. He will, however, cut it according to the method shown in Figure 98. The picture of two of the pieces so made, representing successive cuts from the sirloin side, are shown in Figure 100. In place of these wide sections, several thin ones for steaks may be cut.

In the writers' opinion the rump, as a rule, is best when trimmed of excess fat and cooked by moist heat as braised steaks and pot roasts. An exception can be made, however, of the rump of an extra-good carcass—prime or choice—for it is generally sufficiently tender to make good broiled steaks and roasts, provided it has been allowed to age for 2–6 weeks.

b) The round-steak section (*Fig. 101*).—Most of this section is made up of good-sized muscles, which can be cut across the grain. Near the shank end, however, some of the muscles run lengthwise; all of them are small in size and are bound together by loose connective tissue, as may be seen by holding a slice by one edge and noting the wide stretches of weblike membrane.

It is a point of common knowledge that the round steaks are nearly all lean, with but little fat or bone. Obviously, then, they are an excellent buy with respect to lean meat. The disadvantage, also a matter of common knowledge, is that not much of the meat is sufficiently tender to be cooked by dry heat. The more tender muscles are those on the inside of the leg, which is the "top of the round" when the meat is on the retailer's block, and those of the sirloin tip adjacent to the loin end. The location of the more tender, also the less tender, muscles of the steaks are indicated in Figure 103. Obviously, all these muscles tend to decrease in tenderness at the shank end, where, as just stated, they are small and contain much connective tissue.

As already indicated under the discussion of the grades of beef, the tenderness of all the muscles supposedly varies with the quality of the animal from which they are obtained. Those of a young, well-fed animal of the beef type, the carcass of which has been properly ripened, will be much more tender than those from the unripened carcass of an older, poorly fed animal. It is therefore impossible to make hard-and-fast rules concerning the tenderness of any of the muscles of the round or to state that any of them can or cannot be cooked by dry heat. If, however, the round as it appears in the shop has the characteristics expected of that from a good carcass, as described under grades of meat, the top of the round and the sirloin tip portions of the steak (see Fig. 103) will be tender enough to be cooked by dry heat, provided they are pounded or otherwise mechanically tenderized, previous to cooking. One can easily learn to judge tenderness simply by noting the ease with which the edge of a plate will penetrate the flesh. If the meat is sufficiently tender to be cooked by dry heat, the plate will meet with but little resistance and will make a deep gash when brought down against the flesh with some force. If the plate barely dents the meat, one can be certain that there is a firm network of connective tissue, which needs moist heat to transform it to gelatin, thereby allowing the fibers to fall apart.

Although not all the round-steak section from even the best carcasses can be cooked successfully by dry heat, every bit of that from a carcass of good quality is highly satisfactory when cooked by moist heat—a method which is practically as good as dry heat for the well-done meat that a large number of our citizens prefer.

c) *Heel of round (Fig. 102).*—The heel of round is a pyramid-shaped piece consisting of small muscles interspersed with much connective tissue. In a medium-sized animal this part weighs 5–6 pounds and can conveniently be divided into two small pot roasts or used for stew, soup, or ground meat.

d) *The hind shank.*—This part, as can be seen by consulting Figure 102, is mostly bone. It is used almost exclusively for soup.

Even for this purpose, however, extra lean from the neck, heel of round, brisket, plate, or other parts should be provided.

The regular chuck.—The chuck may be thought of as consisting of three parts, the blade or ribs comprising one, the shoulder arm a second, and the neck a third. In all of these the muscles tend to be small and to run in different directions. The entire chuck, however, is a well-flavored piece of meat. The most tender portion is that bordering on the rib cut—in other words, ribs 4 and 5. In a carcass of high grade which has been suitably ripened, these ribs may even be cooked by dry heat.

The main identifying feature of the rib section is the shoulder blade or, as it is commonly designated, the "blade bone." In ribs 4 and 5, this bone appears as a thin strip separating the muscles lengthwise; but in ribs 1–3 it has the general appearance of a figure 7, owing to the presence of a narrow ridge running longitudinally along its outer surface (see Figs. 79 and 81). The peculiar shape of this bone is reflected in the names "7-bone pot roasts" and "7-bone steaks" occasionally applied to cuts from ribs 1–3.

The shoulder-arm section has somewhat the same appearance as the round but can be distinguished from the latter by the fact that it has anywhere from three to five rib ends, the number depending on whether or not an "English" cut has been removed, and by the characteristic appearance of a small round muscle located near the round bone. This muscle is completely surrounded by loose connective tissue and is quite unlike any muscle of the round.

The neck is one of the least tender cuts of beef, but when the excessive connective tissue has been broken down by cooking with moist heat or by grinding, it compares favorably with other parts. Since it is about 75 per cent lean and is moderately priced, it is an economical source of meat for stew and soup and for ground meat.

A satisfactory method of cutting the chuck is shown in Figure 104, and the appearance of some of the cuts thus made is shown in Figures 105–7.

Courtesy of the National Live Stock and Meat Board

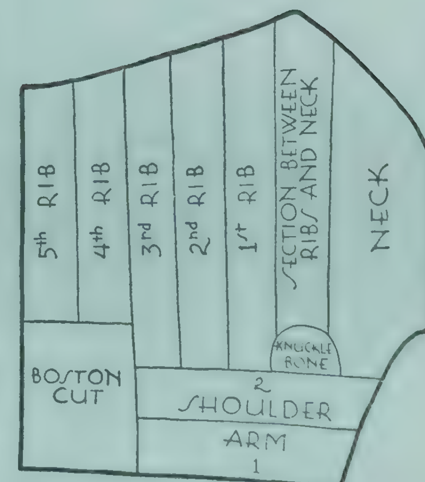


Fig. 104.—The regular chuck (see Fig. 78). The face at the left was separated from the rib cut; the one to the lower right from the brisket and foreshank. The diagram shows a method of cutting the chuck into small retail roasts and pot roasts. The section marked "Boston cut," is now usually called "English cut."

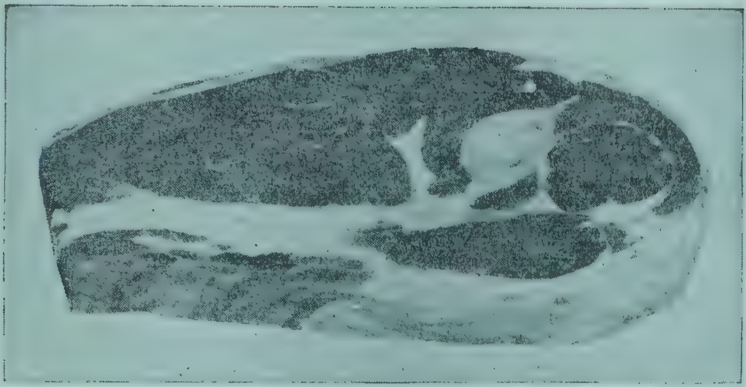


Fig. 105.—Shoulder-arm pot roast, section 2 (Fig. 104). Note the small round muscle to the right of the bone.

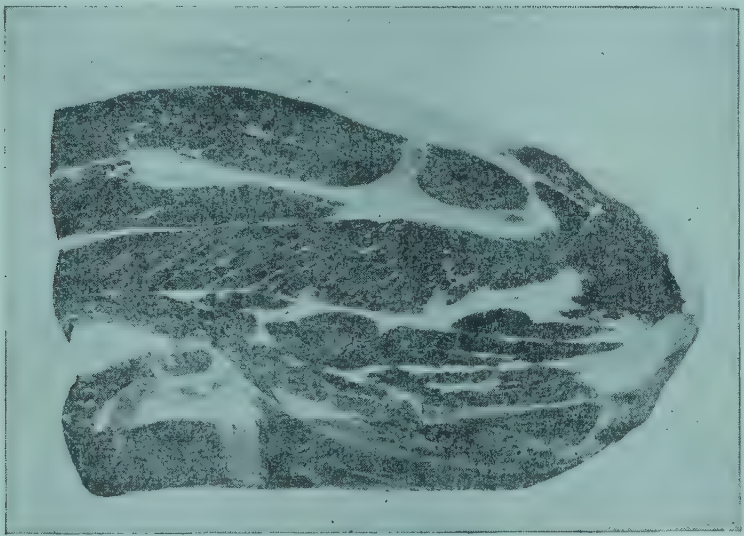
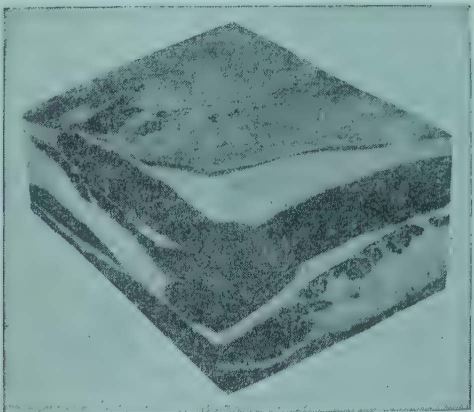


Fig. 106.—Third chuck rib (see Fig. 104). Note the many small muscles, some of which run lengthwise.



Courtesy of the National Live Stock and Meat Board

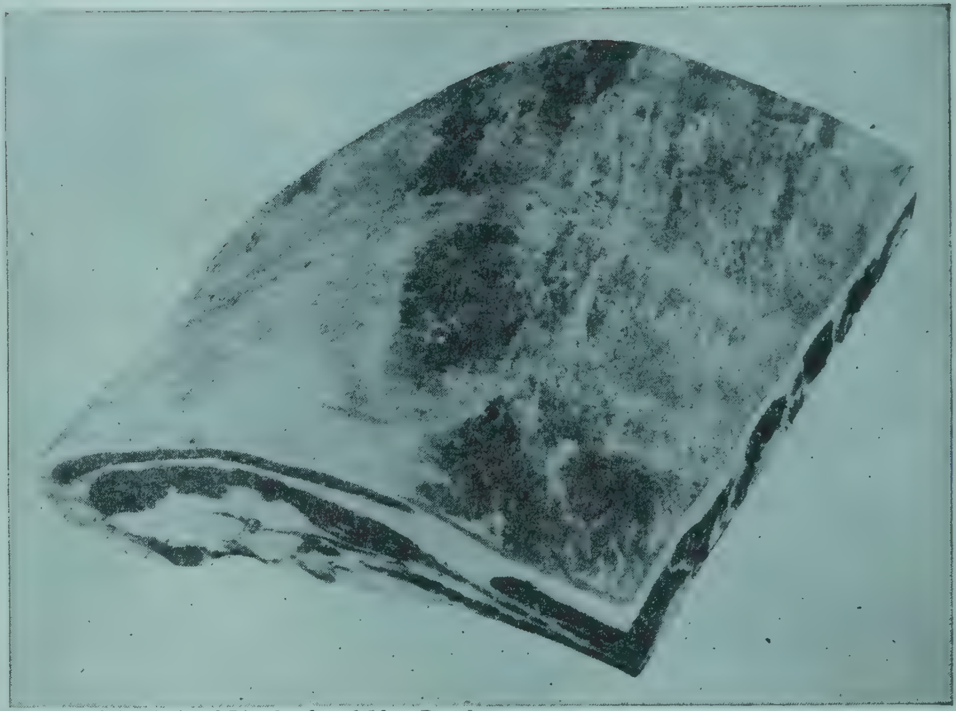
Fig. 107.—English, or Boston, cut (see Fig. 104).

Courtesy of the National Live Stock and Meat Board

Fig. 108.—The foreshank and the pieces into which it may be cut. The top section may be used for stew, soup, or even a pot roast; the lower ones for soup without the addition of extra meat.

Courtesy of the National Live Stock and Meat Board

FIG. 109.—The flank (*above*) (see Fig. 78) and the scored, rolled flank steak (*below*). The cut edge shown in the photograph was separated from the plate. The steak is a thin muscle on the inner side of the flank.



Courtesy of the National Live Stock and Meat Board

FIG. 110.—The short plate (navel) (see Fig. 78). The face in the foreground was separated from the brisket, that to the right from the wholesale rib cut. A strip of rib ends along the edge to the right is known as "short ribs."

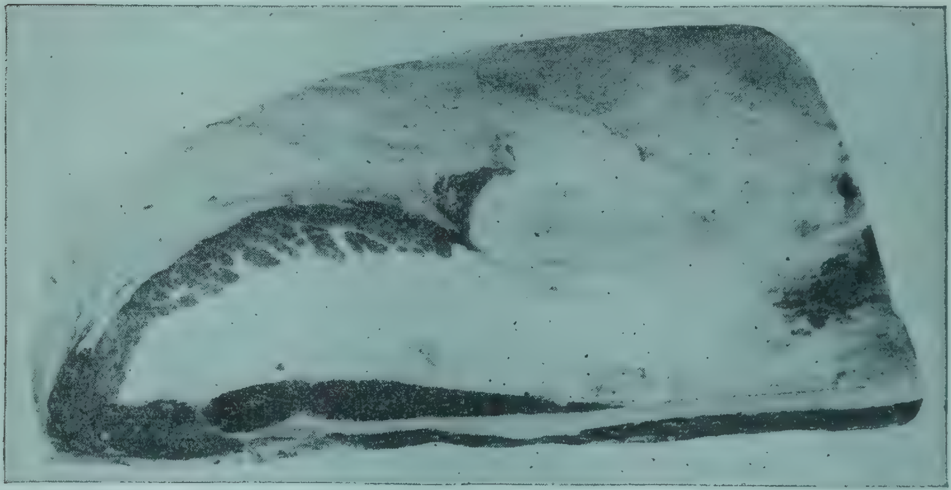
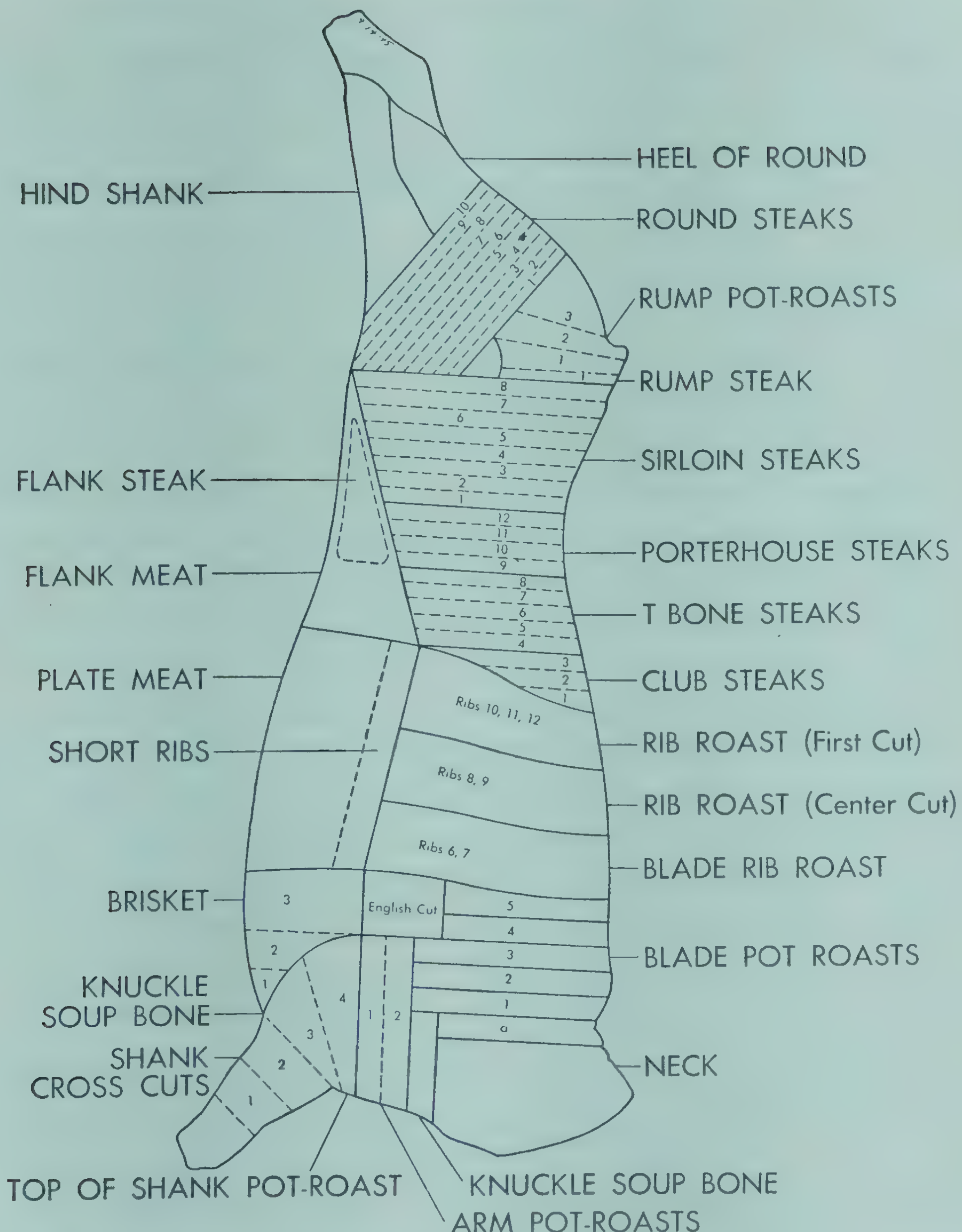


FIG. 111.—The brisket (see Fig. 78). The face at the bottom was separated from the chuck, and the indented section in the foreground from the foreshank.



Courtesy of the National Live Stock and Meat Board

FIG. 112.—Summary of wholesale cuts of beef divided into small retail pieces

The foreshank.—The foreshank, unlike the hind one, has a rather large proportion of meat to bone. The difference between the two can be seen by examining Figures 102 and 108. All the cuts of the foreshank are suitable for soup without the addition of extra lean; the first one may even be used for a pot roast.

The flank (*Fig. 109*).—The flank—that triangular, practically boneless section lying below the loin—is about 1–1½ inches thick and, like bacon, is made up of alternate strips of fat and lean. One rectangular strip of lean from the inner side is peeled out and sold as flank steak. This strip weighs from a pound to a pound and a half. Its muscle fibers are rather coarse and run lengthwise, therefore it tends to be stringy when cooked unless the surface is scored lengthwise and crosswise with a sharp knife before cooking, as indicated in Figure 109. The parts of the flank other than the "steak" are economical sources of soup and stew meat.

The short plate and the brisket (*Figs. 110 and 111*).—The term "short plate" is here used to designate the section lying below the ribs and the term "brisket" the section below the chuck. As has been said, the two together are commonly called the "plate." They resemble the flank in that their muscles run in strips, which alternate with layers of fat; but, unlike the flank, they contain considerable bone, there being present the breastbone and a portion of all the ribs save the thirteenth.

The short plate is sometimes divided into two sections lengthwise, the upper part of which is made up of rib ends and receives the name "short ribs." The remainder of the plate is chiefly used for soup or stew but may be corned. The brisket is commonly boned and corned but, with part of the fat removed, may be used for ground meat, soup, or stew. The thick part at the end may even be used for a pot roast.

Summary.—Figure 112 is a graphic summary of what has been said regarding wholesale cuts (Chicago method) and the small retail pieces into which they were divided.

DIRECTIONS FOR COOKING BEEF

The approximate weights, the number of servings, and the cooking-times given in this chapter are all based on retail cuts from a small carcass weighing 450–500 pounds. This weight was chosen because it is approximately that favored by many meat-dealers in order to provide cuts suitable for a family of two or three people. It is a good idea for those who use these directions to find the approximate weight of carcass their particular retailer tends to buy and, if it is more than 500 pounds (it will hardly be less), to make such adjustments as are necessary in the weight as purchased, number of servings, and cooking-times given in the tables.

BROILED STEAKS

Properly speaking, broiled steaks are cooked by radiant heat supplied by glowing coals, a gas flame, or electrically heated wires; but in actual practice "broiled" steaks are also cooked on a hot pan either in the oven or on top of the stove. The real broiler method is more satisfactory than either of the substitutes and is as easily carried out, provided one has a conveniently placed, easily handled broiler, such as that shown in Figure 27. With broilers awkwardly located under the oven, however, many cooks prefer to use the pan or oven method; hence these two are included in our directions.

The parts of a beef animal which can be broiled successfully are the short loin (club, T-bone, and porterhouse steaks); the sirloin (loin-end) steaks; ribs 6–12; and, from a carcass of high quality which has been properly aged, the face of the rump adjacent to the loin end and chuck ribs 4 and 5.

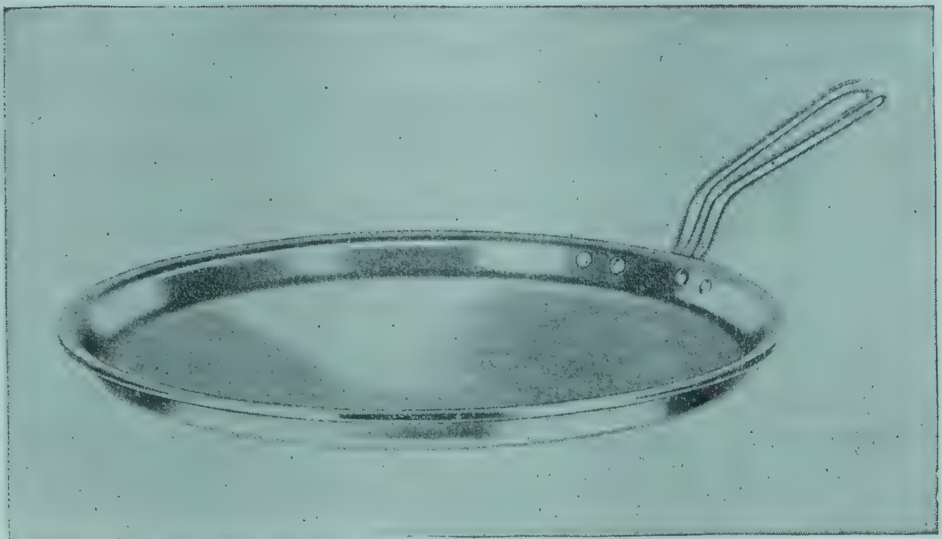
The cooking-time given in the table for broiled steaks is not an exact value even for steaks of the same weight and thickness as those mentioned. Therefore, it is well to test steaks for "doneness" a minute or two before the end of the second half of the cooking-time specified. To do this, simply cut a small gash along the edge of the bone, bend the meat back, and note its color.

Any portion of a broiled steak which is left over may be

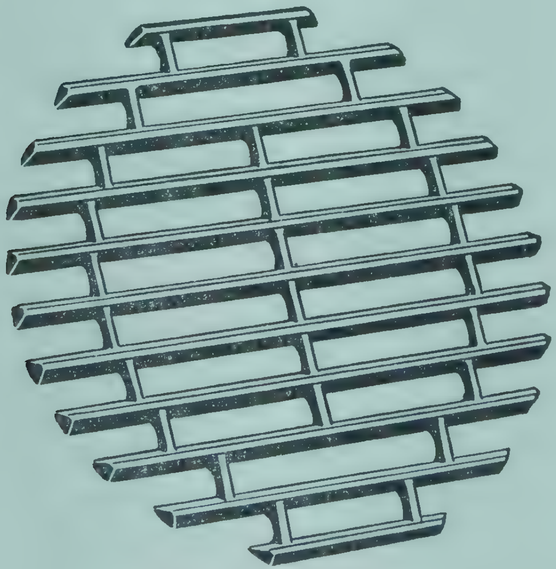
warmed successfully by placing it on a rack in a skillet or grid and heating it in the oven or on the top of the stove for about half the original cooking-period.

Cooked in a broiler.—To use a gas broiler, place the broiler pan approximately 4 inches below the burner, light the burner, and turn the valve handle so that the flame is about $\frac{1}{2}$ inch long. (If the burner is connected with a heat regulator, set the regulator at "broil.") Cut a strip of fat off the outer edge of the steak, pull the broiler part way out of the oven, and, holding the fat on the tines of a fork, grease the rack, then lay the meat on the central portion, close the door of the oven, and allow the steak to cook for half the time specified for that particular one in Table 20; then open the door of the oven, pull the broiler part way out, and sprinkle $\frac{1}{3}$ to $\frac{1}{2}$ teaspoon of salt, the amount depending on the size of the steak, over the surface, then quickly turn with a fork. Close the oven door, cook until the remainder of the period is almost up, and test for doneness. When the steak is done, salt the other side and quickly remove to a platter, which has been heated. Place anywhere from $\frac{1}{2}$ to 1 tablespoon of softened butter on the top of the steak and serve it at once.

Cooked in a pan in the oven.—About 20 minutes before the steak is to be cooked, light the oven and set the regulator at 450° F. For cooking, use a shallow skillet with an all-metal handle, such as that pictured in Figure 113. Set the skillet over a large burner turned high and, while it is heating, cut off a strip of fat $\frac{1}{2}$ inch wide and about 3 inches long from the outer edge of the steak. Place this piece of fat on the skillet and move it about with a fork until a film of fat covers the entire surface, then put the steak on the skillet and sear it for $1\frac{1}{2}$ minutes on each side. Move the steak frequently during searing to prevent it from sticking to the pan. If it shows any tendency to scorch, lower the heat. At the end of 3 minutes, sprinkle $\frac{1}{3}$ to $\frac{1}{2}$ teaspoon of salt, the amount depending on the size of the steak, over the surface, then lift the steak from the pan with a fork and place a rack like that shown in Figure 113 on the pan. Lay the salted side of the steak on the rack, salt the side which is now up, and



Courtesy of the Wear-Ever Aluminum Co.



Courtesy of the Wagner Mfg. Co.

FIG. 113.—The upper photograph shows a shallow aluminum skillet or "grid," which is more satisfactory than a deep skillet for broiling steaks in the oven. The lower photograph shows an aluminum rack to place under pan-broiled and braised steaks.

quickly place the steak in the oven. Allow to cook for half the time specified in Table 20, turn and cook until the remainder of the time is almost up, and test for doneness. When the steak is done, remove it to a platter which has been heated, place anywhere from $\frac{1}{2}$ to 1 tablespoon of softened butter on the top, and serve at once.

Cooked in a pan on top of the stove.—To cook thus, proceed exactly the same as for the oven method except that after the steak is placed on the rack, lower the burner and continue the cooking over it for the time specified in Table 20. The inexperienced person will need to watch the steak constantly and adjust the heat so that the meat will cook quickly and yet not scorch.

FRIED STEAKS

This method of cooking is suitable for steaks that are almost, but not quite, tender enough to cook by broiling. In so far as the writers' experience goes, the only ones which are certain to fall into this category are those from the top of the round and the sirloin tip from a carcass of high quality which has been allowed to ripen for 2 weeks or more.

To prepare steak for frying, cut it in pieces 2 or 3 inches square. Pound these pieces with a meat-pounder until almost paper thin, then roll them in flour and salt, 4 parts flour to 1 of salt.

To fry the steaks heat a skillet over a large burner, place 1 to 2 tablespoons of butter or other fat in the hot skillet; and as soon as the fat has melted, fry the steaks about $1\frac{1}{2}$ minutes to the side. As fast as the pieces are cooked, place them on a preheated platter, spread them with a thin layer of softened butter —about $\frac{1}{2}$ teaspoonful per piece—and serve them as soon as the last one is fried.

BRAISED STEAKS

The method here called "braising" is practically the same as that commonly used in making "Swiss" steak. It consists in pounding the meat, flouring and salting it, searing it, and cooking it covered, hence in the presence of steam, until it is tender.

The parts of a carcass that are especially suited to this method are the steak portion of the round, the shoulder-arm section, the chuck ribs, and the face of the rump. (For this method either face is satisfactory, that adjacent to the round or that adjacent to the sirloin.) As has been stated, in the case of a carcass of high quality which has been properly ripened, it is advisable to reserve the fourth and fifth chuck ribs and the face of the rump adjacent to the loin for broiling. This is especially true if one is cooking for those who have a decided preference for rare meat. But, of course, there is no objection to using these cuts for braised steaks if one so desires.

The data given in Table 21 are all based on steaks cut $\frac{3}{4}$ inch thick. This thickness was chosen to give pieces of a convenient size for a small family.

If a slice of meat selected for a braised steak contains bone, remove this, then pound the meat with a meat-pounder or, if that is not available, with the edge of a plate, to about two-thirds of its original thickness. If it seems decidedly fibrous, as shown by its resistance to penetration by the pounder or plate, cut short gashes of about $\frac{1}{2}$ inch here and there over its entire surface with the point of a cleaver or a sharp knife. In any case, cut here and there around the edges to prevent the meat from curling when cooked. Mix 2 tablespoons of flour and 1 tablespoon of salt on a platter and with this mixture dredge both sides of the steak. Heat a skillet, preferably an iron or heavy aluminum one provided with a well-fitting lid, over a large burner. Place 1 tablespoon of fat in the skillet, tip the latter to spread the fat over the surface, and add the meat. Sear for $1\frac{1}{2}$ minutes on a side. Move the meat frequently during searing to prevent it from sticking. At the end of the 3-minute period, slip a rack such as that shown in Figure 113 under the meat, place the lid over the skillet, and set the latter over a small burner turned very low, as low as it can be without having the flame go out. After about 15 minutes, note whether or not enough water has been extracted from the meat to cover the bottom of the pan. If it has, replace the lid and continue cooking; if it has not,

add $\frac{1}{4}$ cup of water. After a little practice one will not need to uncover the meat to see if it is dry; for, if it is, there will be a hissing noise caused by drops of water falling on the hot, dry skillet; otherwise, there will be practically no sound. The general principle in cooking by this method is to have just enough water present to prevent the steak from scorching and to form enough steam to hydrolyze or split the collagen of the connective tissue to gelatin. If a large amount of water is present, much steam will form, which will condense on the lid, fall back on the meat, and wash the flavoring matter out, so that the cooked meat will be rather insipid, since much of the flavoring will be in the bottom of the pan.

Cook the steak for 45 to 60 minutes or until it is tender when pierced with a fork. At the end of the cooking-period remove the lid; and, if there is more than a spoonful or so of water present, leave the skillet over the heat until the excess water has evaporated; then take the rack out and let the steak brown for about a minute on each side. Remove the steak to a preheated platter, spread $\frac{1}{2}$ to 1 tablespoonful of softened butter over the surface, and serve at once.

ROASTS

The term "roast" is used here exclusively to designate meat cooked in the oven in an uncovered pan without the addition of any water. The meat may or may not be seared, according to personal taste. The advantage of searing is that the surface of the roast is browner and more crisp and therefore more attractive, according to the opinion of some people; the disadvantage is that a seared roast loses a greater quantity of fat and moisture during cooking and therefore shows greater shrinkage than does an unseared one.

The cuts of beef best suited for roasts are the ribs and loins, but other parts of a high-grade carcass which has been properly aged may also be used. This is particularly true if the roasting is done at a low oven temperature.[3] These other parts are a sec-

[3] J. A. Cline and R. S. Godfrey, *A Study of Temperature and Time of Cooking on the Quality and Palatability of Meat* (Missouri Agricultural Experiment Station, Bull. 256), pp. 74–75.

tion of the rump adjacent to the sirloin (loin end), the top of the round, the sirloin tip, and the fourth and fifth chuck ribs.

Since steaks are generally in greater demand than roasts for a small family and since the loin is pre-eminently suited for steaks, we have not given directions for roasting any part of this cut. Sections of the loin are, however, commonly roasted in hotels and restaurants, and they might well be so cooked in the home if the family preference leaned toward roasts instead of steaks. By use of Tables 20 and 22 one can make a rough estimate of the time required for cooking and the number of servings to be obtained from a given number of loin steaks cut in one piece for roasting.

To prepare a roast for cooking, rub the cut edges with a one-to-one mixture of flour and salt, then place it, fat side uppermost, in a shallow pan and insert a meat thermometer, similar to that pictured in Figure 114, in such a way that the bulb is in the center of the muscular portion. The thermometer will go in easily if a hole is made for it with a small skewer and if the stem is supported with the fingers, as shown in Figure 114.

If the roast is to be seared, place it in the center of an oven preheated to 500° F., and at the end of 15 minutes lower the regulator to 300° F.; if it is not to be seared, place it directly in an oven at 300° F. In either case continue cooking until the desired interior temperature is reached. The temperatures for rare, medium-rare, and well-done beef have not been well standardized, but the ones we have chosen are, respectively, 61°, 68°, and 75° C. (142°, 154°, and 167° F.). The time per pound required to reach any one of these temperatures shows considerable variation even for roasts which are of about the same weight and shape; hence one should begin to look at the thermometer in the latter half of the estimated cooking-period. The time given in Table 22 is an average value for meat cooked to the medium-rare stage—68° C.

At the end of the cooking-period place the roast on a hot platter and let it stand in a warm place while the gravy is being made. It will not cool appreciably in 20–25 minutes but will

Courtesy of the Bureau of Human Nutrition and Home Economics, U.S. Department of Agriculture

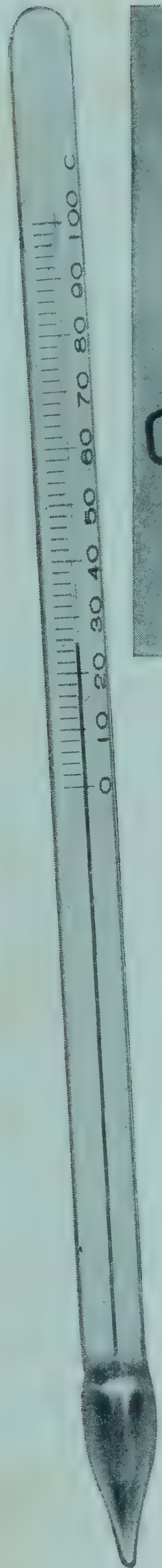


Fig. 114.—A convenient meat thermometer. By use of such a thermometer, inserted into the center of a roast as illustrated above, the degree of "doneness" may be judged easily. The temperatures which we have chosen for the rare, medium-rare, and well-done stages are 61°, 68°, and 75° C., respectively.

The thermometer pictured here costs $2.10 when purchased singly. It may be obtained from the Precision Thermometer and Instrument Company, 1434 Brandywine Street, Philadelphia, or 565 West Washington Boulevard, Chicago. It is calibrated in the Centigrade scale by 2° divisions.

lose a little of its pleasing outer appearance if allowed to stand that long.

The portion of a roast remaining from the first dinner will keep 4 or 5 days without becoming dry if wrapped in waxed paper and placed in the coldest part of the refrigerator. If the left-over piece is fairly large, it will make an excellent hot roast for a second dinner if reheated in the oven at 300° F. for about an hour.

Roast-beef gravy.—Leave all the meat juices and about $\frac{1}{4}$ cup of the fat in the roasting pan; add $\frac{1}{4}$ cup of flour, 1 teaspoon salt, and a sprinkling of pepper. Cook this mixture until the flour has become very brown, then add hot water to give the desired consistency, $1\frac{1}{2}$ to 2 cups, and stir until the gravy is smooth.

POT ROASTS

The method followed for cooking pot roasts is essentially the same as that used for braised steaks, therefore the term "braised roast" might well be used. The only reason for clinging to the name "pot roast" is that it is an old and well-established term.

There are any number of economical cuts for pot roasts. These include all parts of the chuck save the neck and knuckle bone; the rump; the bottom of the round; the heel of round; the front section of the brisket; the short rib; and the top portion of the foreshank.

Pot roasts may be cooked equally well on top of the stove or in the oven, the place chosen depending solely on one's convenience at the moment. Before starting to cook a pot roast, dredge its cut edges with a one-to-one mixture of flour and salt.

If the pot roast is to be cooked on top of the stove, use a heavy aluminum or iron kettle (or skillet), preferably one into which the meat will fit with not more than an inch or so of free space at the sides and top and one which is provided with a well-fitting lid and a rack such as that shown in Figure 113. Heat the receptacle over a large burner turned high, and place in it about 2 tablespoons of fat. When the fat is hot, add the meat and brown it on all sides. This will take 5 to 6 minutes. At the end

of this searing period turn the meat fat side up and slip the rack under it; cover and set over a very low flame. At the end of 15 minutes lift the lid and note whether or not the kettle is dry. If it is, add $\frac{1}{4}$ cup of water and replace the lid. With a little experience one can tell when the meat is dry by the hissing noise coming from the kettle. Once water has begun to come out of the meat, there is usually a period of about 2 hours when but little attention need be given it. As the end of the cooking-period approaches, however, it is well to watch for signs of dryness and add water, if necessary, in $\frac{1}{4}$-cup portions. As in cooking braised steaks, it is desirable to have only enough water to furnish sufficient steam to hydrolyze the collagen of the connective tissue to gelatin, thus allowing the fibers to separate easily. A large amount of water washes the flavoring from the meat and makes it tasteless. For pot roasts of the size recommended in this chapter (see Table 23) a cooking-period of $3\frac{1}{2}$ to 4 hours is usually required, but occasionally a piece of meat will be found that takes even longer. The meat will be done when it can be pierced easily with a fork.

If the pot roast is to be cooked in the oven, put the floured and salted meat, fat side up, on a rack in a pan provided with a well-fitting lid. Set the meat in an oven heated to 500° F. and sear it 15 minutes at that temperature, then lower the regulator to 300° F. Cover the pan and proceed exactly as in cooking on top of the stove; that is to say, after about 15 minutes add $\frac{1}{4}$ cup of water if the pan is dry, and at intervals, especially during the last part of the cooking-period, watch for signs of dryness and from time to time add water in $\frac{1}{4}$-cup portions if necessary.

As soon as the cooking-period is over, remove the pot roast to a preheated platter and set it in a warm place while the gravy is being made.

Pot-roast gravy.—Mix 2 tablespoons of flour with 2 tablespoons of water to make a smooth paste; turn this into the liquid remaining in the kettle after the pot roast has been taken out. Stir the mixture constantly until it thickens, then add water to make about 1 cup of gravy.

STEWS AND SOUPS

Since in making stews and soups the purpose is to extract the juices of the meat, all the water required may be added at the beginning of the cooking-period. As a consequence, but little attention need be given the meat while it is cooking.

The cheaper cuts suitable for stews are the heel of round and the lean from the neck, the top section of the foreshank, and the brisket. The lean of the plate and flank may also be used but is not quite so desirable as the others mentioned because it has to be freed from excess fat and because it contains layers of connective tissue which are apparently made up largely of elastin, since they are not transformed to gelatin even on long cooking but remain as rubbery little sheets. These "sheets," however, can be removed after the meat is cooked and therefore need not prevent the plate and flank from being used in stews.

The cheaper cuts suitable for soup include all those mentioned for stews and, in addition, the third section of the foreshank, the hind one, and the knuckle bones of the chuck and rump. Any bones available that have scraps of meat clinging to them may also be used.

Whatever the cut used for soup, there should be about three parts of lean meat to one of bone, hence some pieces, such, for example, as the bones just mentioned, the first section of the hind shank, and the bones of the neck, will require extra meat.

Stew.—For about 2 cups of stew use $\frac{1}{2}$ pound of lean meat from any of the parts just mentioned. Cut the meat into pieces about 2 inches or so to the side, sear in hot fat, and cook very slowly in 3 cups of water in a tightly covered pan for $3\frac{1}{2}$ to 4 hours. Then add salt and, if necessary, water to make 2 cups of liquid. Heat to boiling, add 1 small potato quartered, 3 medium-sized carrots cut into lengthwise sections, and 1 small onion sliced. Cook for 20 minutes, add dumplings, and continue cooking for 10 minutes longer. The kettle should be kept covered during the cooking of the vegetables and the dumplings. Remove the dumplings, and thicken the stew with $1\frac{1}{2}$ tablespoons of flour mixed to a smooth paste with $1\frac{1}{2}$ tablespoons of cold water. Serve at once.

DUMPLINGS

Yield

Five dumplings, each about 2 inches in diameter.

Approximate preparation time

Two minutes, exclusive of a cooking-period of 10 minutes.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	113	1 cup
or		
Soft-wheat family *or* cake	128	$1\frac{1}{3}$ cups
Baking powder		
Tartrate	11	3 teaspoons
or		
Hydrated phosphate	12	3 teaspoons
or		
Anhydrous phosphate	9	$2\frac{1}{2}$ teaspoons
or		
S.A.S.–phosphate	9	$2\frac{1}{2}$ teaspoons
Milk	122	$\frac{1}{2}$ cup (118 cubic centimeters)

Order of work

1. Weigh or measure the flour and baking powder. Mix and then sift them together.
2. Add the milk to the flour–baking-powder mixture, and stir until the dough becomes so stiff that it is almost impossible to stir it further (about 15 seconds).
3. Place the dough by spoonfuls on top of the meat and vegetables in the kettle.
4. Cover the kettle tightly and cook over a low flame for 10 minutes. Do not open the kettle while the dumplings are cooking.

Soup.—For approximately 6 cups of soup use any one of the following combinations: (*a*) the second and third cuts of the foreshank (Fig. 108); (*b*) the neck bones plus 2 pounds of lean meat; (*c*) the hind shank plus 2 pounds of lean meat; (*d*) the knuckle bone from the chuck plus 2 pounds of lean meat; (*e*) the knuckle bone from the rump plus 2 pounds of lean meat. The neck, brisket, plate, and flank are economical sources of the extra lean. Cut the meat into small pieces and, if the flavor of browned meat is desired, sear all or part of the pieces in hot fat, add 2 quarts of water, cover tightly, and cook over a very low flame for $4\frac{1}{2}$ to 5 hours. Then add salt and pepper and for soups other than plain broth, which some people prefer, such flavorings as may be wished—for example, 1 tablespoon of minced onion and 1 cup of chopped carrots or celery. Continue the cooking for about $\frac{1}{2}$ hour longer, then strain through a double cheesecloth, and set in a cool place until the fat solidifies. When ready to use, remove fat and warm.

ABBREVIATED DIRECTIONS FOR COOKING BEEF

(For detailed directions see pp. 287–99, and for list of cuts suitable for the various methods of cooking, pp. 302–6.)

BROILED STEAKS

a) Cooked in a broiler:

1. Place the broiler pan about 4 inches below the burner. Light the burner, and turn the valve handle so that the flame is about $\frac{1}{2}$ inch long. (If the burner is connected with a heat regulator, set the regulator at "broil.")
2. Oil the broiler rack, put the steak in position, and cook for half of the time specified in Table 20; salt, turn, and cook for the remaining time; salt, transfer to a warm platter, spread with softened butter, and serve at once.

b) Cooked in an oven or over a flame:

1. Try out enough grease from a piece of the steak fat to cover the bottom of a grid or shallow frying-pan. When

this is hot, add the steak and sear it over a high flame for about $1\frac{1}{2}$ minutes; turn, salt, and continue searing for $1\frac{1}{2}$ minutes longer.

2. Slip a rack under the steak and continue cooking either in a baking oven at 450° F. or over a moderately low flame for half of the time specified in Table 20; turn, salt, and continue cooking for the remaining time; remove to a warm platter, spread with softened butter, and serve at once.

FRIED STEAKS

1. Divide the sirloin tip or top of round into individual servings, pound each until it is very thin, and roll in a four-to-one mixture of flour and salt.
2. Cook over a high flame for about $1\frac{1}{2}$ minutes to a side in sufficient hot butter or other fat to prevent sticking—about $\frac{1}{2}$ tablespoon per serving.
3. Remove to a heated platter, spread with softened butter, and serve at once.

BRAISED STEAKS

1. Pound the meat to about two-thirds its original thickness, roll in a two-to-one mixture of flour and salt.
2. Sear $1\frac{1}{2}$ minutes to a side in a very hot, well-oiled frying-pan. Slip a rack under the meat, set the frying-pan over a small burner turned very low, cover tightly, and cook for $\frac{3}{4}$ to 1 hour, adding small quantities of water as necessary.

ROASTS

1. Light the oven and set the regulator at 500° F. if the meat is to be seared, or at 300° F. if not.
2. Rub the roast, especially the cut edges, with a one-to-one mixture of flour and salt, stand it fat side up in a shallow pan, and insert a meat thermometer in such a way that the bulb comes near the center.

3. Sear the meat at 500° F. for 15 minutes, then lower the oven regulator to 300° F., or place the meat at once in an oven at 300° F. Continue the cooking until the thermometer reads 61°, 68°, or 75° C. (142°, 154°, or 167° F.) for rare, medium rare, or well done, respectively. (For approximate time see Table 22.)

POT ROASTS

1. Roll the pot roast in a one-to-one mixture of flour and salt, brown (five minutes or so) in hot fat (about 2 tablespoons), cover tightly, and cook over a very low flame until tender ($3\frac{1}{2}$ to 4 hours), or sear for 15 minutes in an oven at 500° F., cover tightly, and cook at 300° F. until tender ($3\frac{1}{2}$ to 4 hours). By either method add water by small portions if necessary.

TABLE 20

Weights and Cooking-Times of 1-Inch Broiled Steaks from a 450–500-Pound Carcass

A. Club, T-Bone, and Porterhouse Steaks—Broiled

Name of Steak	Steak No.*	Figure No.	Approximate Weight A.P. (Pounds)	No. of Servings †		Approximate Cooking-Time for Medium-rare Stage		
				Without Tail	With Tail	Broiler (Minutes)	Oven‡ (450° F.) (Minutes)	Pan‡ (Minutes)
Club	1							
Club	2	83	1	2	......	9	8	10
Club	3							
T-bone	4							
T-bone	5	84	$1\frac{1}{4}$	2	$2\frac{1}{2}$	10	9	11
T-bone	6							
T-bone	7							
T-bone	8	84	$1\frac{1}{2}$	$2\frac{1}{2}$	3	11	10	12
Porterhouse	9	85						
Porterhouse	10							
Porterhouse	11	85	2	3	$3\frac{1}{2}$	12	11	13
Porterhouse	12							

B. Sirloin Steaks—Broiled

Name of Steak	Steak No.*	Figure No.	Approximate Weight A.P. (Pounds)	No. of Servings †		Approximate Cooking-Time for Medium-rare Stage		
				Without Tail	With Tail	Broiler (Minutes)	Oven‡ (450° F.) (Minutes)	Pan‡ (Minutes)
Pin-bone	1	88	$2\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	13	12	14
Pin-bone	2	89	$2\frac{1}{2}$	$3\frac{1}{2}$	5	13	12	14
Double-bone	3	90	$2\frac{1}{2}$	5		14	8§	10§
Double-bone	4	91	3	6		14	9§	11§
Double-bone	5	92	3	7		14	9§	11§
Round-bone	6	93	3	7		14	9§	11§
Wedge-bone	7	94	$3\frac{1}{2}$	9		15	10§	12§
Wedge-bone	8	95	$3\frac{1}{2}$	10		15	10§	12§

* The club, T-bone, and porterhouse steaks are numbered from the side of the short loin adjacent to the rib cut; the sirloin steaks from the side of the sirloin (loin end) adjacent to the short-loin cut.

† The serving unit is a piece of cooked meat about 3×2×1 inch, which weighs approximately 100 grams or $3\frac{1}{2}$ ounces.

‡ The steaks are seared 3 minutes, exclusive of the time given here.

§ These steaks are too large for the ordinary household skillet, hence have to be divided and cooked in two parts.

TABLE 20—*Continued*

WEIGHTS AND COOKING-TIMES OF 1-INCH BROILED STEAKS FROM A 450–500-POUND CARCASS*

C. Rump Steaks†—Broiled

Name of Steak	Steak No.	Figure No.	Approximate Weight A.P. (Pounds)	No. of Servings	Approximate Cooking-Time for Medium-rare Stage		
					Broiler (Minutes)	Oven‡ (450° F.) (Minutes)	Pan‡ (Minutes)
Rump.......	1	98 100	1	3	10	9	11

D. Chuck Steaks†—Broiled

Name of Steak	Steak No.	Figure No.	Approximate Weight A.P. (Pounds)	No. of Servings	Approximate Cooking-Time for Medium-rare Stage		
					Broiler (Minutes)	Oven‡ (450° F.) (Minutes)	Pan‡ (Minutes)
Chuck.......	1	....	$1\frac{3}{4}$	$4\frac{1}{2}$	11	10	12
Chuck.......	2	....	$1\frac{3}{4}$	$4\frac{1}{2}$	11	10	12
Chuck.......	3	....	$1\frac{1}{2}$	4	11	10	12

* Carcass should be of high grade and well ripened.

† The rump steak is cut from the sirloin side; the chuck steaks are cut from ribs 4 and 5, and are numbered from the side of the chuck adjacent to the wholesale rib cut.

‡ The steaks are seared 3 minutes, exclusive of the time given here.

TABLE 21

Weights and Cooking-Times of ¾-Inch Braised Steaks from a 450–500-Pound Carcass

A. Round Steaks—Braised

Name of Steak	Steak No.*	Figure No.	Approximate Weight A.P. (Pounds)	No. of Servings†	Cooking-Time (Minutes)
Round	1	98	2	....	Top and sirloin tip: 45 to 60 Bottom: 60
Top	....	103	1−	3	
Bottom+eye	....	103	1+	3½	
Round	2	98	2½	....	
Top	....	103	1+	3½	
Bottom+eye	....	103	1+	3½	
Round	3, 4	98	2¾	....	
Top	....	103	1+	3½	
Sirloin tip	....	103	1−	3	
Bottom+eye	....	103	¾−	2	
Round	5, 6	98	3	....	
Top	....	103	1+	3½	
Sirloin tip	....	103	1	3	
Bottom+eye	....	103	¾	2	
Round	7, 8, 9	98	2¾	....	
Top	....	103	1	3½	
Sirloin tip	....	103	1−	2½	
Bottom+eye	....	103	1−	2½	
Round	10	98	2¾	8	

B. Chuck and Rump Steaks—Braised

Name of Steak‡	Steak No.	Figure No.	Approximate Weight A.P. (Pounds)	No. of Servings†	Cooking-Time (Minutes)
Chuck rib	1–13	....	1½–2	3–4	45–60
Shoulder-arm	1–7	....	1¾	3½	45–60
Rump	1–4	100	1	2½	45–60

* The steaks are numbered from the side adjacent to the rump.

† The serving unit is a slice of cooked meat 3½×3½×½ inch, which weighs approximately 100 grams or 3½ ounces.

‡ The chuck ribs, the shoulder-arm, and the sections of the rump shown in the figure listed may be divided into steaks rather than roasts. When cut into ¾-inch slices, they will yield 13, 7, and 4 steaks, respectively.

TABLE 22

WEIGHTS AND COOKING-TIMES OF ROASTS FROM A 450–500-POUND CARCASS

A. Rib Roasts

Name of Roast*	Figure No.	Approximate Weight A.P. (Pounds)	No. of Servings†		Trimmings (Cups)	Approximate Cooking-Time for Medium-rare (68° C. or 154° F.) Roasts Seared for 15 Minutes at 500° F. and Cooked at 300° F. (Hours)
			As Slices	As Short Ribs‡		
Ribs 10, 11, 12 (3, 2, 1)	96, 97	8	13	3	1	$2\frac{3}{4}$
Ribs 8, 9 (5, 4)	96, 97	7	12	2	1	$2\frac{1}{2}$
Ribs 6, 7 (7, 6)§	96, 97	8	7	8	1	$2\frac{1}{4}$
Ribs 11, 12 (2, 1)‖	....	6	10	......	2	$2\frac{3}{4}$
Ribs 9, 10 (4, 3)	....	$6\frac{1}{2}$	11	......	2	3
Ribs 7, 8 (6, 5)	....	5	8	......	$2\frac{1}{2}$	$2\frac{1}{4}$
Rib 6 (7)	....	$5\frac{1}{2}$	7	......	$3\frac{1}{2}$	$2\frac{3}{4}$

* The ribs are numbered according to two systems: In the first, the rib adjacent to the loin is called the "twelfth"; in the second, commonly used by meat retailers, it is called the "first."

† The serving unit is two slices of cooked meat, each about $4\frac{1}{2} \times 3\frac{1}{2} \times \frac{3}{16}$ inch, which together weigh approximately 100 grams or $3\frac{1}{2}$ ounces.

‡ Five and a half to 6 inches of rib ends were removed and cooked as pot roasts.

§ The muscles above the blade bone and $5\frac{1}{2}$ to 6 inches of rib ends were removed and cooked as a pot roast (see p. 265).

‖ In order to provide roasts of different sizes, the wholesale rib cuts have been divided in two ways. In this, the second way, the sixth rib has been cut as large as possible—which means that one of the other groups must be cut small, here the seventh and eighth.

B. Round, Rump, and Chuck Roasts*

Name of Roast	Figure No.	Approximate Weight A.P. (Pounds)	No. of Servings	Trimmings (Cups)	Approximate Cooking-Time for Medium-rare (68° C. or 154° F.) Roasts Seared for 15 Minutes at 500° F. and Cooked at 300° F. (Hours)
Top of round: about $2\frac{1}{2}$ inches thick†	103	$3\frac{1}{2}$	11	....	$1\frac{1}{2}$
Sirloin tip of round: about $2\frac{1}{2}$ inches thick†	103	$3\frac{1}{2}$	10	....	$1\frac{1}{2}$
Rump: $2\frac{1}{2}$ inches thick	100	$2\frac{3}{4}$	4	1	$1\frac{1}{4}$
Fourth and fifth (ninth and eighth) chuck ribs	....	7	9	3	$2\frac{1}{2}$

* Parts of the central portion of the round, the face of the rump adjacent to the loin, and the fourth and fifth ribs from high-grade, well-ripened carcasses, make acceptable roasts.

† Two such roasts may be obtained from the round. The bottom of the round may be used as braised steaks or as pot roasts.

TABLE 23

WEIGHTS AND COOKING-TIMES OF POT ROASTS FROM A 450–500-POUND CARCASS

Name of Pot Roast	Figure No.	Approximate Weight A.P. (Pounds)	No. of Servings*	Approximate Cooking-Time (Hours)
English or Boston	104, 107	$3\frac{1}{4}$	5	$3\frac{1}{2}$ to 4
Shoulder or cross-arm or chuck round bone, sec. 1	104	$5\frac{1}{2}$	11	
Shoulder or cross-arm or chuck round bone, sec. 2	104, 105	7	12	
Blade pot roasts:				
Fifth chuck rib	81, 104	$3\frac{1}{2}$	7	
Fourth chuck rib	81, 104	$3\frac{1}{2}$	6	
Third chuck rib	81, 106	$4\frac{1}{2}$	8	
Second chuck rib	81, 104	5	10	
First chuck rib	81, 104	$4\frac{1}{2}$	8	
Piece between first rib and neck	104	$3\frac{1}{2}$	9	
Top of foreshank	108	5	7	
Brisket, sec. 1	111, 112	$3\frac{1}{2}$	5	
Brisket, sec. 2	111, 112	$3\frac{1}{2}$	4	
Short ribs—piece $5\frac{1}{2}$ to 6 inches wide and 2 to 3 ribs long	112	$1\frac{1}{2}$	3	
Rump, sec. 1; about $2\frac{1}{2}$ inches thick	98, 100	$2\frac{3}{4}$	5	
Rump, sec. 2; about $2\frac{1}{2}$ inches thick	98, 100	$3\frac{1}{2}$	8	
Rump, sec. 3; triangular end piece	98, 100	$3\frac{3}{4}$	8	
Bottom of round†—2 pieces each about $2\frac{1}{2}$ inches thick	103	3	10	
Heel of round—2 pieces	102	$2\frac{1}{4}$	6	

* The serving unit is a piece of cooked meat about $2\times2\times1\frac{1}{2}$ inches, which weighs approximately 100 grams or $3\frac{1}{2}$ ounces.

† Obviously, the top and sirloin tip of the round make good pot roasts, but they are not often so cooked because they are in great demand as steaks and roasts.

CHAPTER XI

MEAL PLANNING

WHETHER she realizes it or not, every good cook who prepares nutritious, appetizing meals at the appointed hour takes three closely interwoven preliminary steps: The first is deciding on a suitable menu in which nutritive value, variety, and attractiveness have all been duly considered; the second is checking over the materials needed and ordering any that are lacking so that all are on hand at the crucial moment; and the third is making a plan of work.

The choice of food from the nutritive standpoint is a large subject which cannot be dealt with adequately here. It is, however, a matter of vital interest to everyone; therefore, the person charged with making the family menus should have at least an elementary knowledge of the subject. Those who have had no training in the field will get much help by reading one of the following books: *An Introduction to Foods and Nutrition* by Henry C. Sherman and Caroline Sherman Lanford (New York: Macmillan Co., 1943); or *Rose's Foundations of Nutrition* by Grace MacLeod and Clara Mae Taylor (4th ed.; New York: Macmillan Co., 1944). For the young woman who must plan meals before she has had time to read and profit by these books, a simple rule can be given which, if followed, will provide meals of proper nutritive value. This rule is: *Include a liberal amount of milk, eggs, fruit, and vegetables in the day's diet and provide at least one serving per person of meat, fish, fowl, or cheese, also plenty of whole grain or enriched bread or cereal.*

It is a good plan for adults to have at least a pint, children

three-fourths to one quart, of milk a day in some form or other and the equivalent of one egg, whether that be served as such or in prepared foods like custards or soufflés. If an egg a day is not available, one serving each of two of the following foods will suffice: beans (navy or lima), macaroni and cheese, peanuts, peanut butter, or cottage cheese.

To meet the fruit and vegetable requirement, at least two servings of each should be provided daily. Preferably, one of the fruits should be oranges, grapefruit, or tomatoes, and one of the vegetables should be of the salad variety, such as lettuce, cabbage, or celery.

The foods mentioned[1] furnish most of the protein necessary for repairing body tissues and of the minerals and vitamins required for health and efficiency; they also provide about half the energy required for an ordinary day's work. The potatoes, butter, and breadstuffs, together with the sweets and other materials used in desserts, will supply the remainder of the necessary components of the diet.

Variety in a given meal is seemingly an easy thing to accomplish, yet some housewives never manage it but go through life serving two or more dishes of surprising sameness at every meal. Thus, one middle-aged woman of our acquaintance almost invariably serves creamed potatoes and creamed macaroni, two white and starchy foods, at the same meal; another makes a point of having mashed potatoes when she has rice. Why anyone should choose to double her work to no purpose is hard to understand. But to the unthinking, one more dish, regardless of its similarity to another, appears worth striving for. A desirable variety, however, does not mean a great variety. A few well-chosen dishes at each meal are all that is necessary. The old-fashioned housekeeper, particularly the one who lives in the country where an abundance of food is available, still tends to exhaust her entire repertory of dishes at each meal, thus making it difficult to have a pleasing variety from one day to another. No matter how good a meal may be, no one wants the same

[1] Nationalities with dietary habits markedly different from ours obviously meet their food requirements by combinations other than the ones suggested here.

combination the following day or regularly on a week from that day. After some twenty years, one of the writers still recalls the loathing she came to have for the excellent Sunday dinner which never varied throughout the first year of her dormitory life. To this day she avoids some of the very good foods that were on that menu.

Few of us probably realize how much our appetite and relish for food depend on its appearance. Fortunately, an attractive meal is as easy to prepare and is as cheap as an unattractive one. The preparation of such meals, however, requires some foresight; otherwise, the one food needed to give a pleasing combination of color, form, or texture may not be at hand. So simple a meal as stew with dumplings, a fruit salad, and a glass of milk may be pleasing in appearance, provided one has a few carrots to lend color to the stew, plenty of green lettuce, and a colored fruit for the salad. Such a meal, we may add, supplies its share of the day's requirement for nutritive value and variety.

Once one has decided on the menu and has the necessary materials on hand, the final step is to make a "timed" plan of work, that is, a plan in which the time for the beginning of each cooking process is indicated. This plan need not provide for the preparation of every article on the menu immediately preceding the meal—an impossible task for the inexperienced save for a very simple meal—but it should be so arranged that everything is done and ready to serve at a given moment. The experienced housekeeper keeps her meal plan in her head and hardly knows she has it there, but the inexperienced one needs hers on paper right before her as she works.

This final step should go hand in hand with planning the menu, for otherwise foods will be chosen which cannot be prepared in the time at the cook's disposal or convenience. One young woman of our acquaintance still speaks ruefully of her first dinner party, which was scheduled for six-thirty but came off at nine, with nothing quite as she intended to have it, simply because some of the foods chosen could not be prepared in the allotted time. In her haste and confusion she had ruined practically everything.

In order to make an efficient time plan which can be followed with any degree of exactness in preparing a meal, one must of necessity know how long it takes to prepare the individual dishes in that meal—and this is the very thing the inexperienced cook does not know. Nevertheless, she can make a workable plan which will insure a meal almost, if not quite, on time. For this she must choose foods which can be prepared for serving or for cooking well ahead of mealtime and which require little or no last-minute preparation for serving. A menu consisting of apple pie, orange and grapefruit salad, baked potatoes, green peas, and braised steak fulfils all these requirements. The apple pie can be made and the potatoes washed in the morning or early afternoon; the salad prepared and the peas shelled (and both placed in a refrigerator) an hour or so in advance of mealtime. The potatoes require no last-minute preparation, the peas and meat only buttering, which takes but a jiffy; therefore, if these foods are started cooking at the proper minute, which can be ascertained from the directions given in this book, the meal is bound to be ready on time. A simpler menu which would cause the beginner no end of difficulty would be one consisting of broiled steak, mashed potatoes, new green cabbage, and strawberry shortcake, for in this meal everything requires last-minute attention.

To avoid all possibility of overlapping tasks, ample time—perhaps twice as much as we suggest in the directions for cooking—should be allowed for the work which is done ahead of mealtime, such as making the pie and preparing the vegetables for cooking in the meal just discussed. This procedure is, of course, not efficient—indeed, it may mean that the time spent on the first meals is spread over a large part of the day—but the novice in meal preparation should not expect immediate efficiency any more than does the novice in any other occupation, from piano-playing to wrapping parcels. It does, however, lead to efficiency, for it gives the beginner the opportunity to record the time actually used—something she would not do if rushed—and to consider ways and means of shortening it at later trials.

When a goodly number of time records have been collected, the young housekeeper can make efficient time plans in which all the processes involved in the preparation of a meal are neatly dovetailed and there are no delays.

As an illustration of the points just discussed, plans have been worked out for several luncheons and dinners. In each, the routine jobs connected with the preparation of the meal, such as setting the table, placing the cream and butter in their proper receptacles, and assembling the dishes which are to be warmed, may be done while the vegetables are cooking.

These meals are planned for a family of two, which means that, of the foods which are markedly better when freshly prepared, only enough for two people is indicated. Of the foods that keep well, however, extra amounts are called for. If but two people are present, the foods left will greatly simplify the preparation of the dinners or luncheons of the next few days. Thus the roast of beef will provide the meat for two more good dinners and a luncheon. These dinners need not be consecutive ones; for, with the low temperature reached in modern refrigerators, even meat can be kept in perfect condition for four or five days. Hence the roast of one day may be re-warmed the third, served cold the fourth, and in a meat pie the fifth, thus allowing for variety at a small cost of labor. The apricots and cookies left from one of the dinners would make acceptable additions to a number of other meals. Part of the apricots might be used for a tasty winter shortcake, part as a breakfast or luncheon dish. The cookies would be particularly nice with ice-cream.

LUNCHEON NOS. I AND II

	Luncheon No. I	Luncheon No. II
Menu...............	Stew with dumplings Lettuce salad with French dressing Buttered toast Orange marmalade Milk	Short ribs or rib ends Buttered asparagus Bread and butter Baked custard Hot chocolate

LUNCHEON NOS. I AND II—*Continued*

	Luncheon No. I	Luncheon No. II
Materials needed especially for the meal...	Lean meat (see p. 297), $\frac{1}{2}$ pound Carrots, about $\frac{1}{2}$ pound Lettuce	Short ribs, $1\frac{1}{2}$ pounds (or rib ends left from a rib roast) Asparagus, about 1 pound
Staples to be checked..	Potatoes, onions, marmalade, salad dressing, flour, salt, bread, butter, baking powder, milk	Butter, eggs, milk, cream, nutmeg, chocolate, sugar, bread, salt
Foods which can be prepared at a convenient period:		
a) For serving......	Salad (any time within the last $\frac{1}{2}$ hour)	Custard
b) For cooking......	Vegetables	Vegetable
Foods which should be started cooking a definite period before the hour set for the meal..	Meat for stew: about 4 hours; onions: $\frac{1}{2}$ hour; potatoes: $\frac{1}{2}$ hour; carrots: $\frac{1}{2}$ hour; dumplings: 10 minutes	Short ribs or rib ends: about 4 hours Asparagus: 15 minutes Hot chocolate: 10 minutes
Foods which require last-minute attention other than serving......	Stew (thickening)	Asparagus (buttering) Hot chocolate
Page references for the recipes............	Stew, 297	Baked custard, 318 Short ribs or rib ends, 306 Buttered asparagus, 29 Hot chocolate, 320

DINNER NOS. I AND II

	Dinner No. I	Dinner No. II
Menu	Pot roast with gravy Baked potatoes Baked Hubbard squash Cabbage-apple salad Butter Bread and beverage, if desired Cherry pie	Roast beef with gravy Buttered potatoes Buttered spinach Celery Butter Bread and beverage, if desired Cooked dried apricots Oatmeal-date-nut cookies
Materials needed especially for the meal	Meat for pot roast (see Table 23, p. 306) Hubbard squash, 2 pounds Cabbage, part of a small head Lettuce, few leaves Red cherries, water packed, one 1-pound, 3-ounce can	Meat for roast (see Table 22, p. 305) Spinach, $\frac{1}{2}$ peck Celery, 2 bunches Dried apricots, 1 pound (3 cups) Dates or raisins, $\frac{1}{2}$ package Nut meats, $\frac{1}{8}$ pound ($\frac{1}{2}$ cup)
Staples to be checked	Potatoes, tart apple, lemon, cayenne pepper, mustard, cream, butter, salt, bread, flour, sugar, lard or other solid shortening	Flour, light-brown sugar, baking powder, rolled oats, butter, milk, cream, bread, salt
Foods which can be prepared at a convenient period:		
a) For serving	Pie Salad (any time within the last half-hour)	Cookies Apricots Celery
b) For cooking	Vegetables	Vegetables

DINNER NOS. I AND II—*Continued*

	Dinner No. I	Dinner No. II
Foods which should be started cooking a definite period before the hour set for the meal	Pot roast: 4 hours Squash: 1 hour Potatoes: 1 hour	Roast (see Table 22, p. 305) Potatoes: $\frac{1}{2}$ hour Spinach: 10 minutes
Foods which require last-minute attention other than serving......	Gravy	Gravy Potatoes (buttering) Spinach (buttering)
Page references for recipes.............	Cherry pie, 188 Cabbage-apple salad, 319 Pot roast, 295 and 306 Baked vegetables, 33 Gravy, 296	Oatmeal-date-nut cookies 120 Apricots (see pie filling, p. 186) Roast beef, 292 and 305 Potatoes, 30 Spinach, 30 Gravy, 295

DINNER NOS. III AND IV

	Dinner No. III	Dinner No. IV
Menu................	Cold roast beef Baked sweet potatoes Buttered broccoli Butter Bread and beverage, if desired Steamed pudding with hard sauce	Braised steak with gravy Mashed potatoes Steamed buttered carrots Tomato salad Butter Bread and beverage, if desired Lemon ice-cream Cake
Materials needed especially for the meal...	Beef roast Sweet potatoes, 1 pound Broccoli, $\frac{3}{4}$ pound Dates, $7\frac{1}{2}$ ounces, pitted Suet, $\frac{1}{8}$ pound Molasses (light colored), $\frac{1}{2}$ cup	Bottom of round, $\frac{3}{4}$ inch thick, about 1 pound Carrots (young), 1 pound Fresh tomatoes, 2 small Lettuce, few leaves Lemons, 4 Coffee cream, $1\frac{1}{2}$ cups Ice, 5 pounds if packed in a mechanical refrigerator Ice-cream salt, $\frac{1}{2}$ pound

DINNER NOS. III AND IV—*Continued*

	Dinner No. III	Dinner No. IV
Staples to be checked	Butter, milk, flour, soda, baking powder, sugar, cinnamon, cloves, allspice, nutmeg, bread	Potatoes, salad dressing, cake flour, sugar, salt, baking powder, eggs, butter, milk, vanilla, bread
Foods which can be prepared at a convenient period:		
a) For serving	Pudding Hard sauce Meat (any time within last half-hour)	Ice-cream Cake Salad (any time within last half-hour)
b) For cooking	Vegetables	Vegetables
Foods which should be started cooking a definite period before the hour set for the meal	Potatoes: $\frac{3}{4}$ hour Broccoli: $\frac{1}{2}$ hour	Steak: 1 hour Potatoes: $\frac{1}{2}$ hour Carrots: 20 minutes
Foods which require last-minute attention other than serving	Broccoli (buttering)	Gravy Potatoes (mashing) Carrots (buttering)
Page references for recipes	Steamed pudding, 317 Hard sauce, 318 Baked potatoes, 33 Broccoli, 29	Lemon ice-cream, 234 Butter cake, 92 Braised steak, 290 and 304 Mashed potatoes, 30 Steamed carrots, 32

DINNER NO. V

Menu	Broiled T-bone steak Mashed potatoes Buttered green cabbage Butter Bread and beverage, if desired Strawberry shortcake with cream

DINNER NO. V—*Continued*

Materials needed especially for the meal....................	T-bone steak, 1 inch thick, about $1\frac{1}{4}$ pounds Green cabbage (loose head), $1\frac{3}{4}$ pounds Strawberries, 1 pint
Staples to be checked...........	Potatoes, butter, sugar, flour, salt, baking powder, lard or other solid shortening, milk, cream, bread
Foods which can be prepared at a convenient period:	
a) For serving...............	Strawberries
b) For cooking...............	Shortcake dough Vegetables
Foods which should be started to cook at a definite period before the hour set for the meal......	Potatoes: $\frac{1}{2}$ hour Steak: 10 minutes Cabbage: 8 minutes
Foods which require last-minute attention other than serving...	Steak Potatoes (mashing) Cabbage (buttering) Shortcake baked during first course and crust and berries combined between courses
Page references for recipes.......	Mashed potatoes, 30 Strawberry shortcake, 149 Broiled steak, 287 and 302 Buttered cabbage, 29

DIRECTIONS FOR PREPARING MISCELLANEOUS FOODS

Directions for preparing such of the foods called for in the menus as are not given elsewhere are included in this section. In addition, general directions for cooking cereals are given.

STEAMED PUDDING

Yield

Eight servings, each about $2\frac{1}{2}$ inches in diameter and 1 inch thick.

Cooking utensils

Tin baking powder or other cans having a total capacity of about 4 cups and well-fitting lids of the same diameter as the can.

Approximate preparation time after a few trials

Twenty minutes, exclusive of the steaming period of about 2 hours.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Flour		
Hard-wheat family	113	1 cup
or		
Soft-wheat family *or* cake	128	$1\frac{1}{3}$ cups
Baking powder (any type)	3.5	1 teaspoon
Baking soda	.....	$\frac{1}{4}$ teaspoon
Cinnamon	.....	$\frac{1}{2}$ teaspoon
Cloves, nutmeg, allspice	.....	$\frac{1}{4}$ teaspoon, each
or, in place of the foregoing spices, spice mixture	.....	1 teaspoon
Dates	170	1 cup (about $\frac{3}{4}$ of a 10-ounce package pitted dates)
Suet	45	$\frac{1}{2}$ cup
Bread crumbs	25	$\frac{3}{4}$ cup
Molasses (a light-colored cooking)	163	$\frac{1}{2}$ cup
Milk	122	$\frac{1}{2}$ cup

Order of work

1. Weigh or measure the flour, baking powder, soda, and spices; mix and then sift them together.
2. Cut the dates and suet into small pieces. Mix them and the bread crumbs with the other dry ingredients, using the hands if necessary.

3. Weigh or measure the molasses and milk. Add them to the other ingredients and stir until all are well combined (about 1 minute).
4. Turn into the cans, cover, and steam for about 2 hours. Serve while warm or store for future use, re-warming before serving. The pudding will keep for several weeks.

HARD SAUCE FOR STEAMED PUDDING

Yield

About $\frac{1}{4}$ cup, which is sufficient for 2 servings of pudding.

Approximate preparation time

About 5 minutes.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Butter....................	13	1 tablespoon
Sugar.....................	50	$\frac{1}{4}$ cup

Order of work

1. Cream the butter until it is very plastic and a light-yellow color.
2. Add the sugar in small portions (about $\frac{1}{2}$ tablespoon) and beat after each addition until the mixture looks very fluffy.
3. Set aside in a cool place until served.

BAKED CUSTARD

Yield

Four servings of about $\frac{1}{2}$ cup each.

Baking pan

Four custard cups, each with a capacity of about $\frac{2}{3}$ cup.

Approximate preparation time

Five minutes, exclusive of the baking period of about 40 minutes.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Eggs	96	2 eggs
or		
Egg yolks	72	4 yolks
Sugar	100	$\frac{1}{2}$ cup
Milk	488	2 cups
Nutmeg	...	$\frac{1}{2}$ teaspoon

Order of work

1. Beat the eggs in a bowl large enough to allow the custard to be mixed without spattering until the yolks and whites are well blended.
2. Weigh or measure the sugar. Add it to the eggs, or to the egg yolks, to which a few tablespoons of the milk have been added, and stir until the two are well mixed.
3. Stir the milk into the egg-sugar mixture, gradually at first.
4. Pour the custard into the baking cups, sprinkle the nutmeg over the top, and set the cups in a pan of hot water. The pan should be deep enough so that the water comes as high as the custard.
5. Bake at 350° F. until a knife stuck into the center of the custard comes out clean (about 40 minutes). Cool before serving.

CABBAGE-APPLE SALAD

Mix together about 1 cup of shredded cabbage, $\frac{1}{2}$ cup of shredded or diced apple, $\frac{1}{4}$ teaspoon of mustard, $\frac{1}{4}$ teaspoon of salt, $\frac{1}{2}$ tablespoon of sugar, 1 tablespoon of lemon juice, a sprinkling of cayenne pepper, and 2 tablespoons of cream. Set in a cool place until ready to serve.

Yield

Two $\frac{1}{2}$-cup servings.

HOT CHOCOLATE

Yield

About 2 cups

Approximate preparation time

About 5 minutes, exclusive of a 2–3-minute cooking-period.

Proportion of ingredients

	WEIGHT IN GRAMS	APPROXIMATE MEASURE
Bitter chocolate	28	1 square
Sugar	12	2 tablespoons
Salt	...	$\frac{1}{8}$ teaspoon
Hot water	...	$\frac{1}{3}$ cup
Cream	60	$\frac{1}{4}$ cup
Milk	366	$1\frac{1}{2}$ cups
Vanilla	...	$\frac{1}{4}$ teaspoon

Order of work

1. Place the chocolate in a cooking-pan, and set this pan inside another containing hot water until the chocolate has melted.
2. Mix the sugar and salt with the melted chocolate, stir in the hot water, and bring to a boil.
3. Add the cream and milk, stir well, and heat to almost the boiling-point, stirring occasionally. Add the vanilla, and serve at once.

ORANGE MARMALADE[2]

Yield

About 7 cups ($4\frac{1}{2}$ pounds).

Utensils

Cooking-pan, capacity 4 quarts. The one used in this laboratory is 9 inches in diameter. Seven jelly glasses, each with the capacity of 1 cup.

[2] Reprinted by permission of *McCall's Magazine*.

Proportions of ingredients

	WEIGHT Grams	Ounces	APPROXIMATE MEASURE
Oranges (sliced)....	400	14	$2\frac{1}{2}$ cups (2 large oranges)
Lemons (sliced)....	200	7	$1\frac{1}{2}$ cups (3 medium sized)
Lemon juice.......	30	..	2 tablespoons (juice of 1 medium-sized lemon)
Water............	1,200	..	5 cups
Sugar.............	1,200	42	6 cups

Order of work

1. Select two large, firm, thin-skinned oranges which together weigh about 1 pound, and four medium-sized lemons which together weigh about 10 ounces.
2. Wash fruit, cut off blossom ends, cut the oranges in eighths, and three of the lemons in quarters; then slice each section crosswise in thin slices. Extract juice of fourth lemon and add to sliced mixture.
3. Measure the water and add the fruit to it. Let the mixture stand overnight or cook it at once. (We have evidence that there is no advantage in allowing the cut fruit to stand overnight.)
4. While the fruit is cooking, do the following:
   a) Wash the glasses or jars in which the marmalade is to be stored. Place them, with their lids, in a pan, cover them with water, and set them over the heat.
   b) Weigh or measure the sugar.
   c) Place 2 or 3 silver or heavy metal teaspoons on a small plate and set them in the coldest part of the refrigerator.
5. As soon as the fruit is cooked, remove it from the fire and weigh or measure it. If the weight is less than 2 pounds, 3 ounces, or the measure less than 5 cups, add water to bring it to this weight or volume.
6. Add the sugar to the cooked fruit and stir the mixture un-

til all of the sugar is dissolved. Then heat to boiling, and boil to a temperature of 103° C. (217° F.). (If a thermometer is not available, note the time the mixture begins to boil and let it boil briskly, but without much foaming, for 20 minutes.) When the temperature of the mixture has reached 103° C. (217° F.), remove the pan from the heat and make the spoon test (see step 7).

7. *Spoon test.*—Fill one of the chilled teaspoons one-third full of clear liquid, using an extra spoon to remove the hot material from the kettle. Replace the cold spoon in the refrigerator, making sure that the handle of the spoon is so supported that the liquid does not run out of the bowl. At the end of 5 minutes remove the spoon from the refrigerator and turn over the mixture in the bowl with a spatula or knife, noting the condition of the underside. If it is a jelly, the mixture is ready to be turned into glasses. If it is still a liquid, replace the mixture on the fire, heat it quickly to boiling and boil for 3 minutes, then repeat the test. Continue to boil and test until the desired consistency is reached.
8. Turn into glasses.
9. When the marmalade has cooled so that the surface has jellied, cover it with a thin layer of hot melted paraffin. When the jelly is cold, add another layer of hot paraffin and place lids on the glasses.

FRENCH DRESSING

Proportion of ingredients	APPROXIMATE MEASURE
Sugar	1 teaspoon
Salt	$\frac{1}{2}$ teaspoon
Mustard	$\frac{1}{4}$ teaspoon
Pepper	$\frac{1}{8}$ teaspoon
Lime or lemon juice or vinegar	3 tablespoons[3]
Salad oil	$\frac{1}{2}$ cup[3]

[3] Salad bottles with calibrations for the quantities of acid and oil called for in these directions are available in the kitchenware departments of most stores.

Add the sugar, salt, mustard, and pepper to the lime or lemon juice or vinegar, stir the mixture, and turn it into a bottle. Add the oil and, just before using, shake well to combine the ingredients. If desired, add a clove of garlic.

BREAKFAST CEREALS

The quantity of cereal and water required to give approximately $2\frac{1}{2}$ cups of the cooked product have been determined for a large number of cereals cooked for 20 and for 60 minutes. The results obtained are summarized in the following paragraphs. In all cases the cereals were added to the boiling salted water in the upper part of a double boiler, cooked over an open flame for about 1 minute, then for the time specified over hot water.

Granular cereals prepared from the inside, or endosperm, of the grain, such as (*a*) Farina, Yellow Corn Meal, Cream of Wheat, Mello Wheat, Cream of Rice, and Malt-O-Meal, require $\frac{1}{2}$ cup of the cereal and $2\frac{2}{3}$ cups of water for a 20-minute, and $2\frac{3}{4}$ cups of water for a 60-minute, cooking-period; (*b*) White Corn Meal requires $\frac{2}{3}$ cup of cereal and $2\frac{1}{2}$ cups of water for either a 20- or a 60-minute cooking-period.

Rolled or flaked cereals, such as Quick Cooking or Rolled Oats, New Pettijohns, New Oata, and Three Minute Oats, require $1\frac{1}{2}$ cups of cereal and $2\frac{3}{4}$ cups of water for a 20-minute, and 3 cups of water for a 60-minute, cooking-period.

Granular cereals prepared from the whole grain, such as Heinz Breakfast Wheat, Ralston's Whole Wheat, Wheatena, Elam's Scotch Style Oatmeal, Wheatsworth, and Fruitized Health Wheat, require $\frac{2}{3}$ cup of cereal and $2\frac{1}{3}$ cups of water for a 20-minute, and $2\frac{2}{3}$ cups of water for a 60-minute, cooking-period.

Cracked Wheat requires $\frac{2}{3}$ cup of cereal and $2\frac{1}{2}$ cups of water for a 60-minute cooking-period.

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